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MOVERS and SHAKERS® 2006

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JUNE 2006

THE DEFINITIVE GUIDE TO LEADERSHIP IN GLOBAL ELECTRONICS

how and where to

GROW

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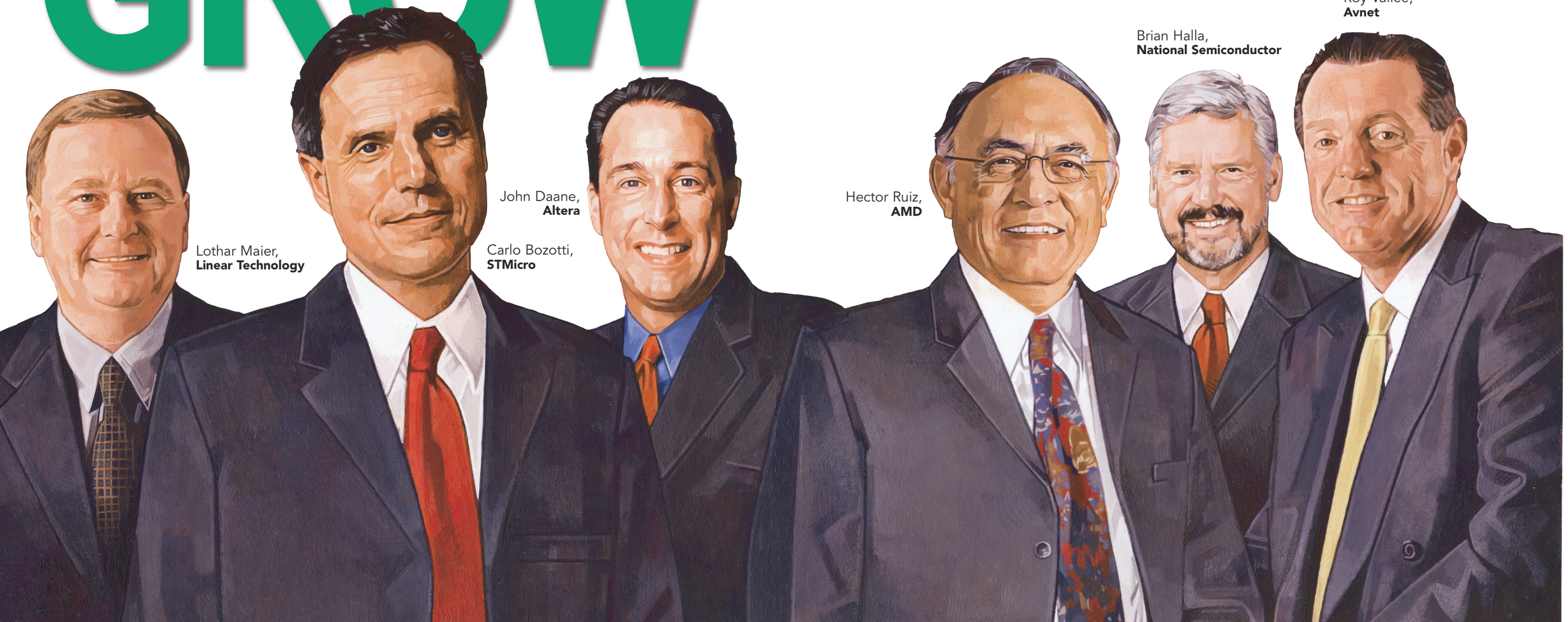

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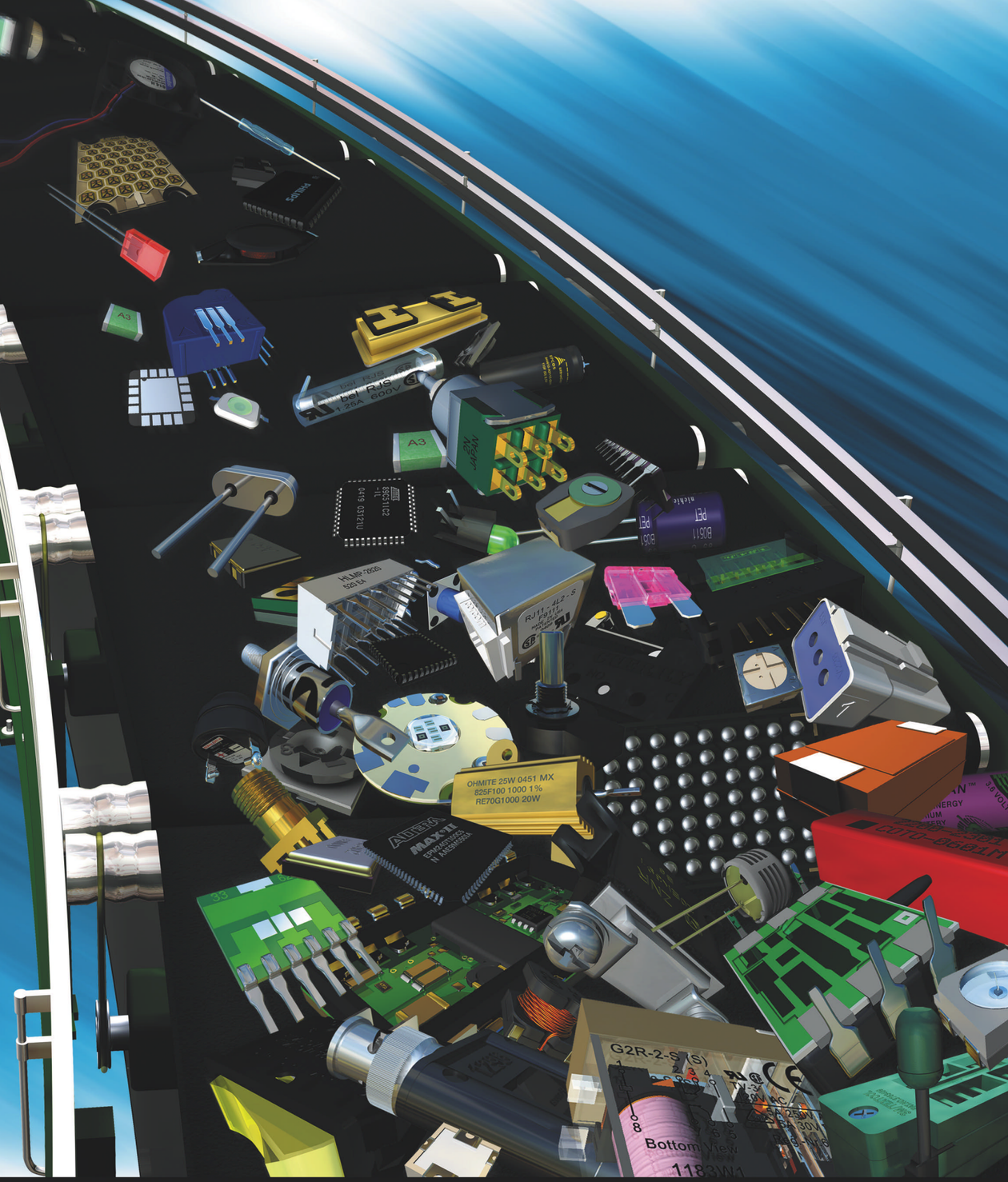

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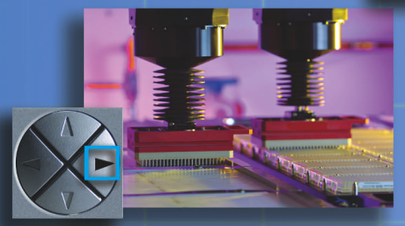

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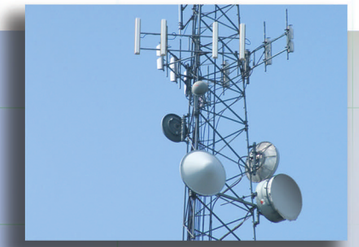

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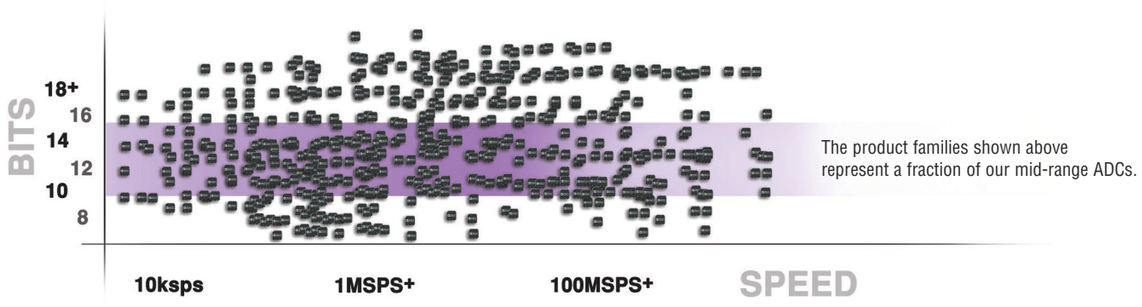

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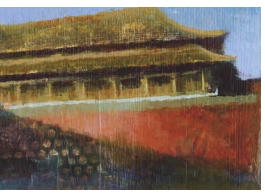

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Welcome Again and So Soon!

By John Dodge

WELCOME TO *MOVERS AND SHAKERS* 2006. You might be wondering why you are seeing us so soon again after the 2005 version last November. We felt 2005 research such as you see in our Market Leaders would be fresher in June than last year when comparable data was nearly a year old upon publication. As the only magazine that annually takes stock in the electronics industry, *Movers and Shakers* 2006 presents you with an exhaustive, credible and current overview of today's electronics marketplaces so you can plan for tomorrow.

The 2006 version is has been simplified into four sections, but it is just as chock full of insights as was the 2005 edition. However, to guide us this time around, we had the benefit of a reader survey conducted after the 2005 *Movers and Shakers*. And the regional forecasts scored the highest in terms of value. So, we packaged all five regional forecasts in their own section.

The second section is our Market Leaders where we monitor year-to-year leadership in 16 product categories. In *Movers and Shakers* 2006, the explosive growth in flash memory warranted its own category. And we added a DRAM category. Accordingly, each chart listing the top ten 10 companies is accompanied by a market "size-up" which as the name suggests, assesses that category. Last year, we profiled just the top player in each category.

Then we have the centerpiece of *Movers and Shakers*—interviews with electronics industry leaders. We hit many important execs we missed in 2005—Brian Halla from National Semi; Altera's John Daane; Xilinx's Wim Roelandts; Hector Ruiz from AMD, the world's fastest-growing semiconductor company; and Lothar Maier from Linear Technology, which very well might have the best profit margins in the business.

I want to give special mention to Rambus, which made big news in late April when it won a $306.5 million judgment against Hynix, sending shock waves through the memory community. Our Q&A with Rambus CEO Harold Hughes offers insight to how a company operates when it is constantly involved in litigation and successful courtroom drama of late.

The second industry Q&A I want to specifically mention is Carlo Bozotti, who was appointed CEO and president of STMicroelectronics in March, 2005. To the best of our knowledge, there have been no in-depth interviews in the American media with ST's new CEO, who in his first year operated under the radar screen. Even though ST moved from the sixth to the fifth largest semiconductor company in the world, only 13% of it's business is in North America. A whopping 46% percent of sales is in the Asia/Pacific region (including China) and 31% percent is in Europe. Does that scare anyone?

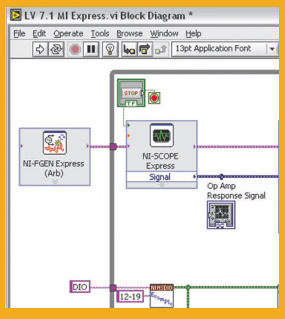
Our final major section is The Customer Connection. No one can develop true insight into technology and business trends without talking to customers. This year's lineup includes Rockwell Automation Chief Technical Officer Sujeet Chand; Samsung senior vice president of technical marketing Jon Kang; and VP operations Collin Malcolm from $17.1 billion automotive supplier Lear Corp.

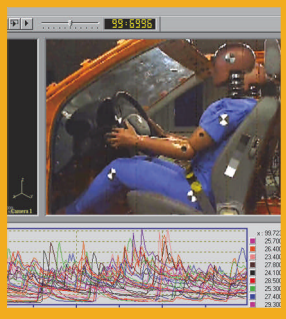
We round out our coverage with Global Output in Electronics, which assesses electronics output by region to determine what geographies are running strong or are in need of some adrenalin. Our source is the *Yearbook of World Electronics Data* published by our sister organization Reed Electronics Research in the U.K. HotSpots (a regular department in *Electronic Business* magazine) this year are concentrated in the Far East—India, Indonesia, Malaysia, Korea, Taiwan and Mainland China. Along with that, we've added a column by Reed Economist Jim Haughey, whose forecasts regularly score high in our readership studies.

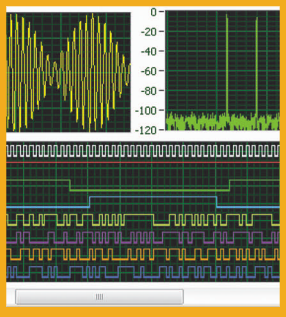
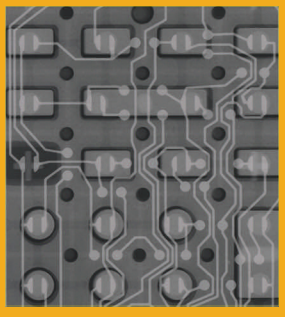
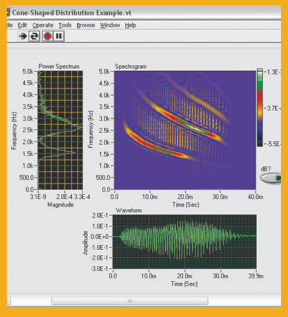
One popular feature missing from *Movers and Shakers* 2006 included last year is the popular Global 250 feature, which ranked the top 250 electronics companies by percent growth within four size groups. The reason it doesn't appear in this issue is because the Global 250 this year will not be completed until the August issue of *Electronic Business* magazine. So the new June publishing date for *Movers and Shakers* made including it impossible. Fear not, though. An expanded and renamed Global 250 along with the EB300 will appear in the August issue of *Electronic Business*.

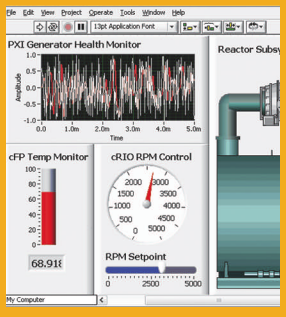
And stay tuned for an improved *Movers and Shakers* 2006 Web site along with several e-mail newsletters. As always, let me know what you think at john.dodge@reedbusiness.com or at my blog, www.eb-mag.com/tdr. ■

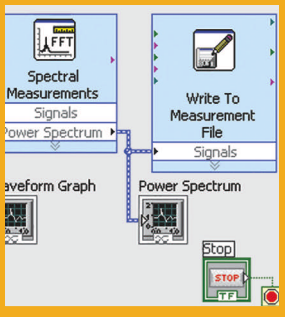
John Dodge is editor-in-chief of Movers and Shakers *and* Electronic Business.

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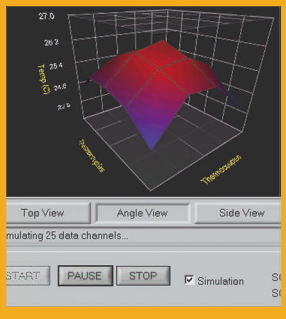



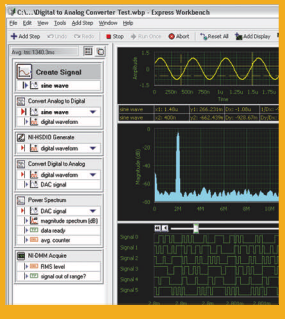

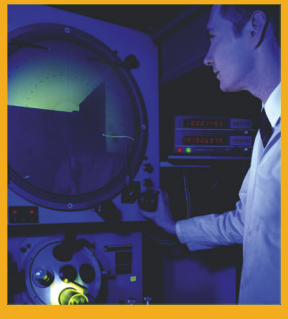
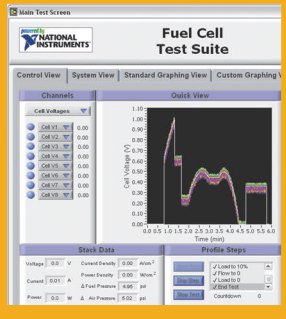

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NATIONAL INSTRUMENTS™

Changes in China Afoot

By Jim Haughey

Three evolving trends in the world economy will change the character of the electronics market in 2006-07 while electronics sales continue to expand faster than the overall economy. World economic growth will average above the sustainable long-term growth pace of about 4 percent although the growth pace will progressively slow from well above average early in 2006 to about average at the end of 2007. Four years of strong economic growth during 2004-07 will strain production capacity. On the supply side, this will raise production costs, especially in China, speeding up the dispersal of production to the next round of cheap production countries. On the demand side, this will raise the share of electronics sales to the capital goods market relative to consumer electronics and will also raise the share of electronics final demand in developing countries.


Jim Haughey

In the key electronics-consuming markets, economic growth is forecast to ebb during 2006-07 from 3.5 percent to 3.0 percent in the United States, from 2.5 percent to 2.0 percent in Japan and from 9.0 percent to 8.0 percent in China. But growth will accelerate from 2.0 percent to 2.5 percent in Europe. GDP growth began 2006 very strong, especially in the United States, as most businesses were building inventory back to normal levels. However, when inventory stocking is completed the growth pace will slow. And this slowing will be aggravated by the slowdown in housing construction in the U.S.

Rising production costs-—which always accompany strained capacity—have been evident in China for about a year, appeared in the United States last fall, were seen in Japan early in 2006 and are likely to appear in Germany by summer. So far, non-electronics manufacturers have experienced the largest increases for materials and labor and logistics. Inflation resulting from capacity shortages will fully reach electronics manufacturers later this year when the slow post-holiday production period ends in late spring. Component and semiconductor prices will hold firm as they did last fall. Credit costs are also increasing worldwide but only by about 50 to 70 basis points this year and will be less significant in total production costs than material and labor cost increases.

Already, rapidly rising Chinese costs are beginning to divert production to the new cheapest countries, including Vietnam, Bangladesh and Indonesia. This is more pronounced in textiles and household goods, where factory operating margins are smaller than in electronics. However, semiconductor sales to the Asia/Pacific region weakened considerably early in 2006, partly due to more assembly work outside of China. Geographically, the supply chain will get more complex.

Wage, benefit and labor recruiting costs are largely responsible for the relatively rapid rise in Chinese production costs. How can a country with many tens of millions of unemployed and underemployed workers be short of labor?

New government tax policies have reduced the incentive for rural-to-urban migration. The surplus of workers with experience operating machinery has been nearly exhausted by many years of rapid factory expansion. A huge rise in college enrollment has removed millions of young workers from the labor pool. And the "one child" policy put in effect several decades ago has now begun to reduce the number of new entry level workers each year. Chinese factories now have to search for new workers instead of simply hiring those who appear at their door. ■

Jim Haughey is director of economics for Reed Business Information.

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Fairchild Power Switch (FPS™)
Insulated Gate Bipolar Transistor (IGBT)
Light Emitting Diode (LED)
Metal Oxide Semiconductor
Field-Effect Transistor (MOSFET)
Motor Driver - SPM™
Optocoupler
Triac

7:30am pacific time
San Francisco, California

Fairchild parts*inside* LCD television
Audio Amplifier
Bridge Rectifier
Fairchild Power Switch (FPS™)
Inverter Controller
Load Switch
Low Dropout Regulator (LDO)
Power Factor Correction (PFC)
Quantum Field-Effect Transistor (QFET) MOSFET
Stealth Diode
Video Filter

10:30am eastern time
New York, New York

Fairchild parts*inside* laptop
DC-DC Controller
Light Emitting Diode (LED) Driver
Linear Regulator
Low Drop Out Regulator (LDO)
Metal Oxide Semiconductor
Field-Effect Transistor (MOSFET)
Pulse Width Modulation (PWM)
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Diode
Fairchild Power Switch (FPS™)
High Voltage IC (HVIC)
Insulated Gate Bipolar Transistor (IGBT)
Optocoupler
Power Factor Correction (PFC)
Pulse Width Modulation (PWM)
Controller
Quantum Field-Effect Transistor (QFET)
Video Filter
Voltage Regulator

4:30pm standard time
Paris, France

Fairchild parts*inside* cell phone
Analog Switch
Audio Amplifier
DC-DC Converter
Light Emitting Diode (LED) Driver
Load Switch
- IntelliMAX™
µSerDes™
RF Power Amplifier Module (PAM)
Serializer/Deserializer
Video Filter

3:30pm standard time
London, England

Fairchild parts*inside* digital camera
Analog Switch
DC-DC Converter
Insulated Gate Bipolar Transistor (IGBT)
Light Emitting Diode (LED) Driver
Load Switch
- IntelliMAX™
Logic
µSerDes™
Serializer/Deserializer

11:30pm standard time
Singapore

Fairchild parts*inside* CFL bulbs
Ballast Control IC
Bipolar Transistor
Bridge Rectifier
Quantum Field-Effect Transistor
(QFET) MOSFET

greennote

Power used by a mobile phone/PDA on standby: **1.84 watts**
Power used by a mobile phone/PDA on standby with Fairchild's Green FPS components: **0.29 watts**
Savings with Fairchild components: **1.55 watts**

If every mobile phone sold worldwide in 2005 was on standby 50% of the time and realized this 1.55 watt savings, enough power would be saved on an annual basis to supply power to approximately 500,000 households in the United States.

greennote

Power used annually by an average washing machine: **698 kilowatt-hours**
Power used annually by the same washing machine using Fairchild components: **565 kilowatt-hours**
Savings with Fairchild components: **133 kilowatt-hours a year**

If every one of the 70 million washing machines produced globally in 2005 used Fairchild energy efficient products, the savings would be equal to the approximate amount of power generated by the Hoover Dam in over two years. This is no small feat. The Hoover Dam generates more than 4 billion kilowatt-hours a year, enough to serve the electrical needs of 1.3 million people.

greennote

Power used by a standard incandescent light bulb: **60 watts**
Power used by a fluorescent (CFL) bulb with Fairchild components: **15 watts**
Savings per bulb with Fairchild components: **45 watts**

If each of the 923,000 households in Singapore used an average of five 60 watt lightbulbs and switched from incandescent bulbs to CFL bulbs that include Fairchild components, the city would save enough power, just from the bulbs, to light more than 69,225 homes!

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Solid GROWTH *is in the forecast*

By John Dodge and Ed Sperling

Barring inventory oversupply or disasters of the man-made or natural sort, the next 12 to 18 months for the U.S. semiconductor industry will build on the momentum of 2005.

That's the consensus from top industry executives and market analysts, all of whom harbor vivid memories of the industry's worst years, early in the decade. Estimates of how much the market will actually grow varies from one analyst to another and from one executive to another. But all of these market watchers predict at least some growth if none of the variables run amok.

Worldwide, semiconductor sales are expected to grow 7.9 percent this year, to $245 billion, up from $227.5 billion in 2005, according to the Semiconductor Industry Association (SIA). And it may get better—much better, in fact. iSuppli is forecasting 7.4 percent growth this year and a whopping 12 percent in 2007. And Gartner is predicting growth well into the high single digits this year, with a flatter 2007 and up to 14 percent growth in 2008.

In the United States, overall electronics production for 2005 was just under $276 billion, according to the *Yearbook of World Electronic Data* (published by Reed Electronics Research, a sister organization to the division that publishes *Movers and Shakers*). All told, the U.S. still accounts for about 45 percent of all semiconductors consumed worldwide, which makes it the single largest market. But with Asia's appetite for consumer electronics showing sustained growth and manufacturing and design now parceled out to several different geographies, actual numbers are becoming much harder to define by region.

At present, there is growth in every region. The U.S. GDP is projected to grow 3.3 percent in 2006—down from 3.5 percent in 2005, largely as a result of increases in energy prices. The U.S. consumer price index, meanwhile, will be 2.8 in 2006, down from 3.1 in 2005. If that sounds somewhat negative, consider that Semico predicts the U.S. semiconductor market will grow 13 percent this year. Although overall economic growth is down, electronics is growing.

So, is the electronics industry entering another era of irrational exuberance? The very notion sends chills down the spines of electronics executives who survived the earlier part of this decade. U.S. electronics output in 2005 increased about $5.5 billion over 2004, which is roughly equal to how much electronics production dipped from 2002 to 2003.

Cautious optimism would seem to be the prevailing sentiment. "You need to do more with fewer resources," says Altera's vice president of product and corporate marketing, Danny Biran. More with less, of course, is a central theme in Altera's programmable logic pitch, but you'd have a hard time finding an American semiconductor executive who doesn't agree with this thought.

Electronics industry optimism is as high as it's been in the United States in seven years. "The U.S. market is very strong," says Biran, adding that heightened spending in telecommunications and military electronics is driving much of Altera's growth.

High-performance analog IC supplier Linear Technology sees a bright outlook both in the United States and worldwide, driven by new expanding markets such as hybrid automobiles and solar panels, according to Linear's president, Dave Bell. Indeed, the fastest growing vertical market worldwide will be automotive, which iSuppli forecasts will average 10.5 percent growth

each year between 2004 and 2009.

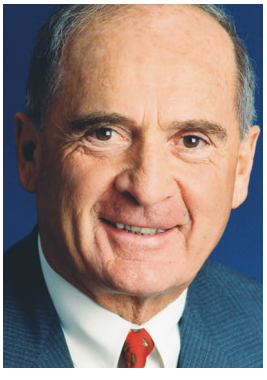
"The change toward higher performance is positive for us. One new area is energy efficiency. We have $100 of our parts in one hybrid vehicle model," Bell says, without revealing which one. "Every market is becoming higher performance. Five years ago, you would have said I was crazy if I'd said that high-performance analog ICs went in TVs, but that's changing with LCD and plasma TVs."

Unlike the heads of many U.S.-based but far-flung semiconductor companies, Bell also still sees the United States as the locus for design and development. After Linear opened a Munich design center in April this year, nine out of 10 of its design centers were still based in the United States. Fully half of its demand creation still originates on American soil.

"Five years ago, that dropped into the low 40 percent range, but it's back at 50 percent," says Bell, adding that by *demand creation,* he means design of end products by a company's customers. "With the Apple iPod, we attribute the demand creation to Cupertino, where the iPods are designed."

One concern that faces analog suppliers such as Linear, Analog Devices and Texas Instruments is a perpetual shortage of analog designers. The prevailing belief a few years ago was that electronics was going digital—lock, stock and barrel. Indeed, the opposite happened. The analog category is not only flourishing but it's forecast by iSuppli to become the second-fastest-growing semiconductor category between 2004 and 2009, at 9.6 percent growth in revenue a year. (The No. 1 growth market is sensors and actuators, at 9.8 percent annually.)

Dave Bell
Linear Technology



George Scalise
Semiconductor Industry Association

Gary Grandbois
iSuppli

Two Dynamics to Watch

From a management perspective, keeping two factors under control will keep the industry on track, says George Scalise, president of the SIA, the primary lobbying group for U.S semiconductor companies. Those factors are accurately matching component inventories with demand and making sure the industry does not overspend on manufacturing capacity.

"The cautionary areas are inventory and capacity control. We have to maintain control in those two areas," he says. These dynamics worry Scalise more than the threat of terrorism, sky-high energy prices, supply shortages and competitive threats from China. "I don't see how they would affect us any more than anyone else. Everyone pays the price on terrorism and high energy prices," he says.

As for China, Scalise is unconcerned about the world's most populous nation's posing any imminent threat to American supremacy in semiconductor design or even in manufacturing. "I don't see anything from China in the next five years that would put it in a challenging—let alone leadership—position. If it's going to happen, you have to look out five to seven years before those issues emerge as significant."

The major U.S. vulnerability relates to semiconductor consumption, says iSuppli's Gary Grandbois, principal analyst. Chip consumption in 2006 rose a meager 2.5 percent domestically, compared to 15 percent in China. "There is some growth, but not at the pace of other markets. The bulk of the growth is somewhere else."

So far, energy shortages and high oil prices have not affected the U.S. electronics industry, but they will eventually catch up to sales, according to Grandbois. "They should have a dampening effect. We've been worrying about it, but it has not shown an impact yet. After gasoline prices spiked, they came back down. Invariably, shortages and high prices will have an impact, but there seems to be a time lag. They are not affecting our 2006-07 forecasts."

CapEx Grows

Another way of measuring the market is by looking at the capital equipment used in manufacturing semiconductors. Normally, capital expenditures on manufacturing equipment run years behind increases in production. Not this year. Dean Freeman, principal analyst for semiconductor manufacturing at Gartner, says there is plenty of available space inside fabs for new equipment. That means the equipment can be bought, installed and turned on for production relatively quickly—something measured in weeks rather than years.

The growth in the market for capital equipment alone is expected to run well into the high single digits, starting at about 9.5 percent for the first two quarters of 2006, according to Gartner, and wafting down slowly—largely as a result of Microsoft delays in shipping its Vista operating system.

Freeman says capital equipment sales were expected to be flat in the first part of 2006 but rose unexpectedly as companies invested heavily in equipment to make DRAM and flash memory. Although most of that is being driven by the consumer market, at least some of the sales were in anticipation of PC sales that will be delayed until at least early next year.

"Semiconductors will rise 9.5 percent in 2006 over 2005," he says. "Our numbers are coming down a little, but growth will still be in the high single digits."

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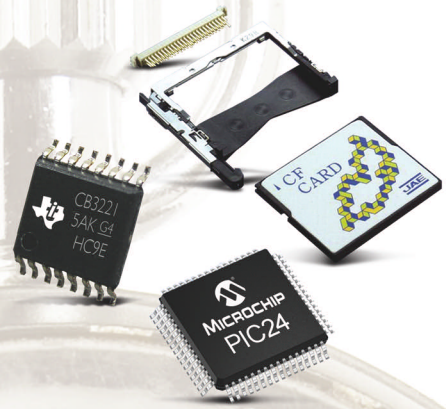
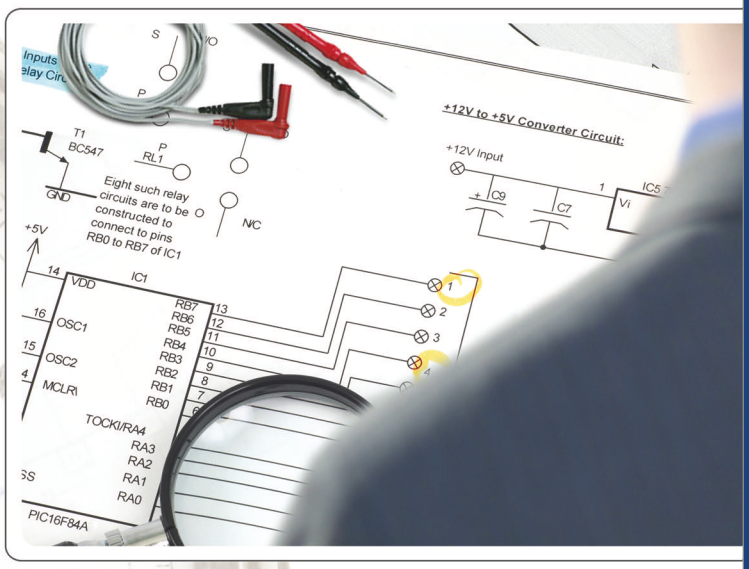


Time-to-Market Advantage for New Designs



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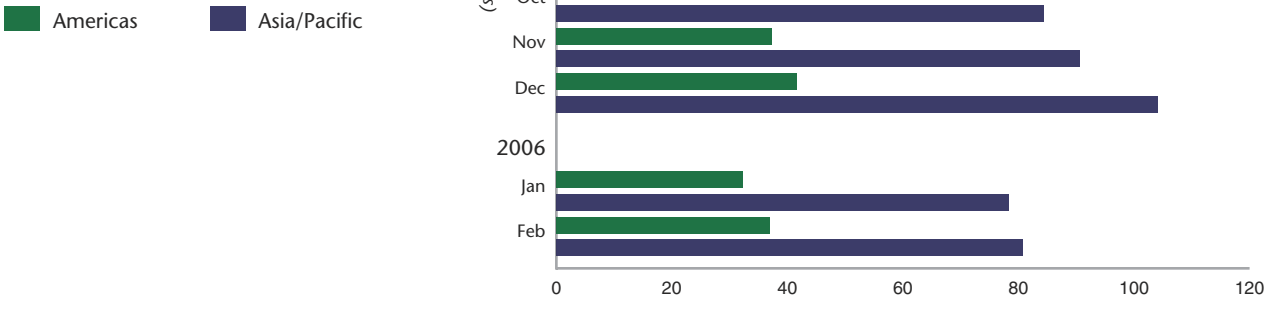
Asia/Pacific Semiconductor Sales Eclipse Americas

Month-to-month actual semiconductor sales were a bit of a roller coaster ride in 2005, but overall showed steady growth. Through February, growth in the Americas was up 58 percent over the corresponding period a year ago. Still, Asia/Pacific production started outpacing the Americas in 2001 and the gap continues to widen.



Source: Semiconductor Industry Association

Continued from page 18

Gartner expects sales to slow down in 2007, although remaining positive, with a potential boom year in 2008. That depends, of course, on several factors, ranging from interest rates to fuel costs.

Growth Engines

What will drive the next boom is largely a matter of conjecture. Gartner says that historically there is a direct correlation between the Summer Olympics and the sales of home entertainment equipment. But unlike in the past, it may not be any single factor.

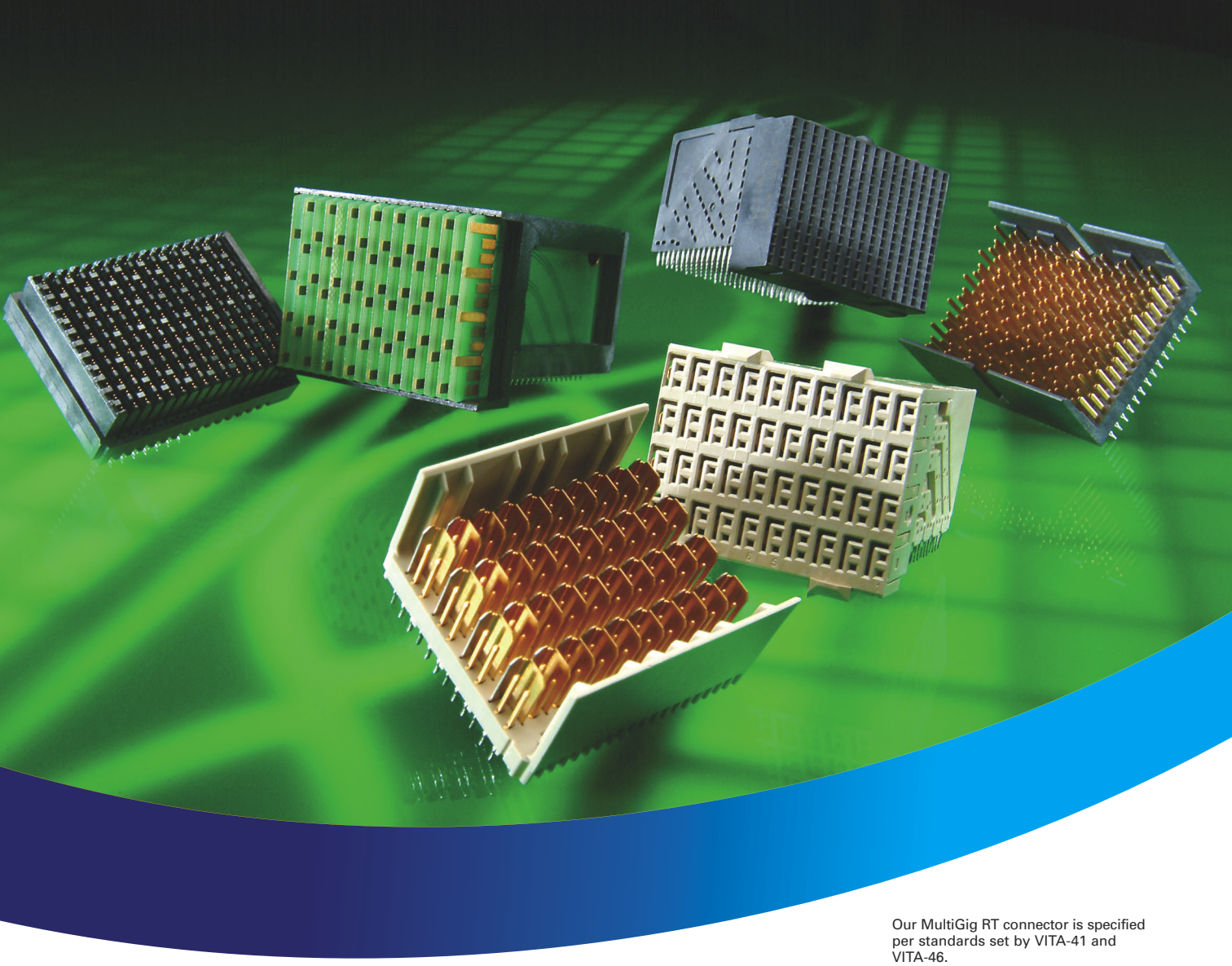
Jim Feldhan, president of Semico, is placing bets on five separate areas, which will materialize in different phases. The first is digital broadcasting, which will fuel the market for digital televisions and high-definition DVD players. He says the market will grow when digital broadcasting becomes the standard, in 2008.

The second growth area revolves around microfuel cells for consumer devices. "If you can get an MP3 player that runs 60 hours on 20 milliliters of alcohol, there will be a market for it," says Feldhan. "That type of performance for a cell phone and notebook computer will drive a huge upgrade cycle. The communications industry has been in the doldrums since 2000. In the next couple of years, we'll begin to see a rebound. Fuel cells will be part of that. One of the key decisions was a positive ruling from the U.S. Federal Aviation Administration, which says they're safe for use on planes. You can have them on commercial aircraft starting in the second half of 2007."

A third growth area is storage, which continues to be a lucrative market for both the home and business. Fourth, retinal projection should take off over the next few years, as prices continue to drop and performance improves. Using virtual keyboards and displays also consumes substantially less power than using a 15-inch LCD screen. Fifth is the automotive market, which is growing at a rate of about 8 percent for semiconductors.

"About 2 percent to 3 percent of the growth is attributable to new markets, such as India and China," Feldhan says. "The remainder is increased content for global positioning systems, telematics, wireless, fuel efficiency and safety. Right now, that has only a 2 percent to 3 percent penetration rate." ■

John Dodge is editor-in-chief for Electronic Business. *Ed Sperling is editor-in-chief for* Electronic News.



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THE BIG-FISH STRATEGY:

Engine of CHINA'S

By Yao Gang

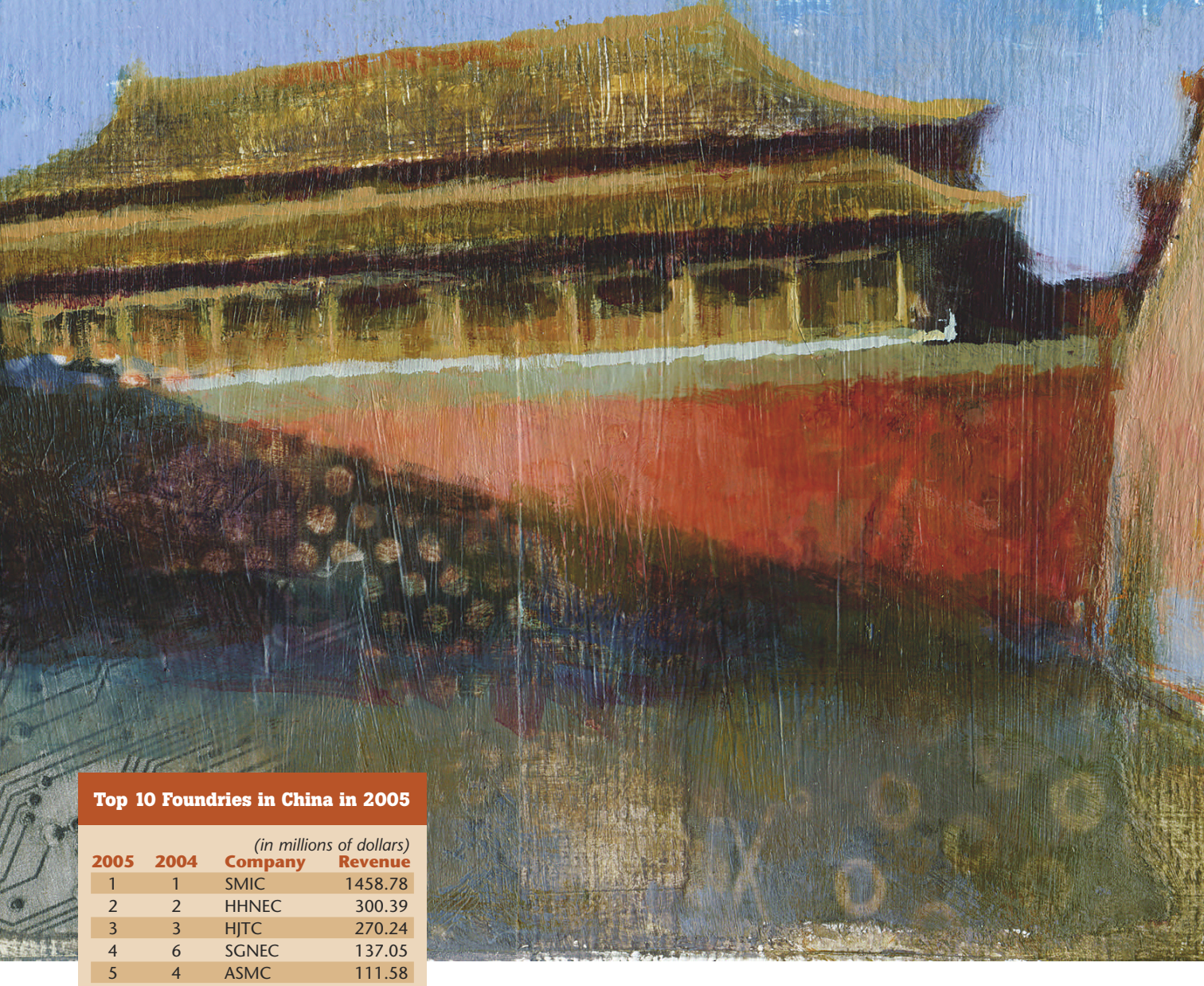
THIS YEAR, THE MAJOR PLAYERS of China's electronics industry will demonstrate an evolutionary trend of growing ever bigger, with the industry transforming itself from the phase of quantitative expansion to one of qualitative improvements powered by technological innovations. The 11th Five-Year Plan of China's IC industry also explicitly reflects its inclination to promote this "big fish" strategy.

The Chinese government plans to invest a total of 300 billion yuan($37.45 billion) during the 11th Five-Year Plan period, according to Wenwu Ding, vice director of the department of electronic and information products of the Ministry of Information Technology (MII). This figure will go toward developing five IC design companies, each worth 3 to 5 billion yuan($374.5 to $624.2 million), and 10 companies, each worth 1 to 3 billion yuan($124.8 to $374.5 million). Ten 200-millimeter and five 300-mm wafer foundry production lines are also planned during the same time period. In terms of semiconductor manufacturing equipment, the Chinese government plans to achieve self-supply of all equipment for the 150-mm production lines, commercialize mask aligners for the 200-mm production lines and attain technological breakthroughs in the development of 65-nanometer laser-etching equipment for the 300-mm production lines.

The 11th Five-Year Plan will see breakthrough IC product innovations and priority will be given to the introduction and re-innovation of imported technologies, according to Zhongyu Yu, director of the China Semiconductor Industry Association (CSIA) Over the next five years, the compound annual growth rate (CAGR) of China's IC industry will reach 28.1 percent. By 2010, China will become the largest semiconductor market, worth about $150 billion, according to the CSIA.

The goals for the Chinese electronics and information industry set this year by MII are to generate sales revenue of 4.66 trillion yuan($574.2 billion) in total, up 23.31 percent from 2005. But the effect of the new hot products market on China's electronics industry is still limited.

Regarding 3G, Xudong Wang, minister of MII, indicates that this year will see the formulation of services, tariffs and regulatory policies on 3G, as well as



Top 10 Foundries in China in 2005

(in millions of dollars)

2005	2004	Company	Revenue
1	1	SMIC	1458.78
2	2	HHNEC	300.39
3	3	HJTC	270.24
4	6	SGNEC	137.05
5	4	ASMC	111.58
6	5	GSMC	106.32
7	7	HHMC	104.14
8	8	CSMC	75.09
9	9	JLMC	64.94
10	10	BCD	43.59

Source: China Semiconductor Industry Association

allocation of the frequency spectrum. A prediction against such a backdrop is that 3G will be only at its introductory stage before 2007, whereas large-scale commercialization won't be possible until 2008.

As for LCD TV, considering that the national digital television standards are not yet developed and launched, it is not easy for a product priced at about 10,000 yuan($1250) to enter average families' homes unless the prices of LCDs can quickly approach those of CRTs, which is quite unlikely, given that the LCD panel accounting for 70 percent of the total cost of a complete TV set is wholly imported.

MP3 players and GSM handsets are facing the problem of excessive supply. Digital video products such as MP4s and Portable Media Players (PMPs) are still in a market-nurturing stage, and before any substantial

GROWTH

progress in the 3C integration policy can be achieved, Internet Protocol Television (IPTV) is not likely to be applied on a large scale. With the transformation from analog TVs to digital TVs, set-top boxes (STBs) are beginning to enter mainstream homes in larger quantities. However, the analog-to-digital transformation is usually financially supported by local governments, and certainly there are not yet many well-off cities in China.

It will be two to three years before the demand for these new products will reach the same penetration level as GSM handsets, DVDs and CRT TVs.

Except for the IC design segment-which saw continued rapid growth in 2005 growth in all the other segments of China's electronics industry showed a slowdown trend in 2005. China's electronics industry is experiencing the pain of the continued lack of self-owned core technologies. According to MII statistics, for roughly the top 100 Chinese electronics companies, the average profitability rate was merely 1.93 percent during the period of January to November 2005. Chinese companies' strategy of grabbing market share by lowering prices has come to an end. By contrast, however, companies driven by technological innovations have demonstrated strong competitiveness.

For example, in 2005, Zhuhai Actions Semiconductor realized sales revenue of 1.26 billion yuan($157.25 million), making it the largest IC design company in China, and net profit of the company rose to $73.1 million, up 176 percent over 2004. Hisilicon Technologies had only several dozen employees when it spun off from Huawei in 2005. That number has now grown to 870 and is expected to reach 1,500 by the end of this year. Although most local mobile phone manufacturers are struggling for survival, the sales of Lenovo mobile phones rose by 238 percent in the third quarter of 2005.

In December last year, MII signed an agreement with the Chinese State Development Bank, under which the bank would offer a credit line totaling 50 billion yuan ($6.24 billion) over the next five years to support the development of the electronics and information industry and the applications of IT. Local Chinese companies with technological capabilities will be the key targets for the Chinese government in supporting the electronics industry.

If the pioneering companies that emerged in the mid- to late 1990s, which together are called Ju Da Zhong Hua (for Ju Long, Datang, ZTE and Huawei), are seen as having been the first wave in the evolution of China's electronics industry, then Zhong Hua Lian Hai (ZTE, Huawei, Lenovo and Haier) have become the leading players in the second wave of the evolution over the first five years of the 21st century. The change from Ju Long and Datang to Lenovo and Haier not only reflects the industry's partial evolution from the manufacturing sector to a complete transformation-expanding from the communications market alone to the PC consumer electronics markets-but also objectively and vividly demonstrates that the industry is turning its eyes from the domestic market to the world market. Adopting such a development orientation, China's electronics industry is brewing the third evolutionary wave. ■

Product Structure and Self-Sufficiency of China's IC Market

Product segment	Market size (in billions of dollars)	Locally produced
Analog devices	7.68	1.72
ASICs	1.16	0.41
ASSPs	6.60	Very few
Logic devices	2.37	0.73
Memory	10.44	0
Computational microprocessors	6.67	0
Embedded microprocessors	1.94	Very few
DSP	1.11	Under development
Microcontrollers	3.64	0.38
Microperipherals	5.33	Very few
IC cards	.43	0.32
Total	47.37	3.93

Source: China Semiconductor Industry Association

Application Structure and Self-Sufficiency of China's IC Market in 2005

Application area	Market size (in billions of dollars)	Local provider
Computer	20.28	0.61
Consumer	12.81	2.08
Communication	8.68	0.56
Industry control	3.49	0.24
Auto electronic	0.53	0
IC cards	0.43	0.32
Other	1.14	0.12
Total	47.37	3.93

Source: China Semiconductor Industry Association

Top 10 Chinese IC Design Houses in 2005

2005	2004	Company	Revenue (in millions of dollars)
1	3	Action Semiconductor	156.60
2	5	Vimicro	95.67
3	4	CEC Huada Electronic Design	79.79
4	2	Hangzhou Silan Microelectronics	75.44
5	1	Datang Microelectronics Technology	71.28
6	9	SHHIC	46.49
7	7	Hangzhou Youwang Electronics	31.21
8	6	Shaoxing Silicore Technology	29.14
9	N/A	Tongfang Microelectronics	28.91
10	7	China Resources Semico	28.43

Source: China Semiconductor Industry Association

Yao Gang is a senior editor for EDN China *and* Electronic Business China.

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ODMs, EMS reign supreme

By Robert L. Scheier

Move up the value chain or die.

That's the challenge for electronics manufacturers across Asia in 2006, as OEM customers put relentless pressure on them to constantly cut costs without sacrificing quality. To differentiate themselves from their rivals and justify prices high enough to make decent profits, Asia's electronics manufacturers must offer unique products and services.

For some, differentiation comes in the form of services performed before the product hits the manufacturing floor, such as writing the embedded software for a mobile phone. For others, it comes during the assembly process, in the form of advanced environmental testing or real-time quality reports to the customer. For others, it comes after the product ships, in the form of repair, warranty or support services. But the aim in each case is to hang on to every precious point of profit.

Blurring Business Models

This mandate has resulted in a blurring of the two dominant business models in Asian manufacturing: electronic manufacturing services (EMS), in which a vendor assembles a product designed elsewhere, and original design manufacturing (ODM), pioneered by Taiwanese firms, which now design as well as manufacture products such as notebook computers for major OEMs.

"Most of the EMS players are turning to ODM" because net profit margins in simple manufacturing have fallen over the past several years to as low as 5 to 10 percent, says Prakash Vaswani, an analyst at market research firm In-Stat. He cited EMS players such as Venture Corp. and Asustek Computer, which are increasingly moving into ODM services.

Working more closely with

OEMs on product design can also give manufacturers the flexibility in materials, components and suppliers they need to meet future demands for price cuts from the OEMs, says Jeffrey Wu, an analyst at market research firm iSuppli. Other EMS and ODM vendors are purchasing or merging with component vendors, he says, so they can capture some profits from the components to blunt the razor-thin profit margins in manufacturing.

Some are also providing services such as environmental testing of products or real-time reporting of manufacturing and quality to their OEM customers. EMS vendors "have all seen the outsourcing model grow, and now we're seeing them move from just taking on the manufacturing to also taking on the design of the product on behalf of their customers," says Bob Krysiak, STMicroelectronics' corporate vice president and general manager for the greater China region. "They're moving up the food chain and adding more value to their customers and to their products and services." This allows the end customer, the OEM, to focus on issues such as channel management and branding, he adds.

Such changes require STMicroelectronics, as a component supplier, to move up the value chain itself in its discussions with contract manufacturers. "As they design and make the [product] on behalf of the OEM, they may have more power in deciding" which components go into the product, says Krysiak. Rather than merely discussing logistics issues—such as how many units it can deliver, to which factory and at what price—STMicroelectronics now needs to be able to describe to the contract manufacturer the features and benefits of its processors and other components.

Even as manufacturers move into higher margin design services, Vaswani urges them to "move closer to your end customer. You may need to take up service and warranty service for your end customer, and maybe have your own direct sales so you can find out what the demand is from the market."

Regional Players

This struggle up the value chain takes different forms in different countries, each of which is trying to make the most of its historic strengths while overcoming its weaknesses.

Hanging over every regional competitor is ***China,*** which analysts and observers agree will continue to be the premier location for all forms of electronics manufacturing for the foreseeable future. China's dominance is guaranteed, they say, by its huge domestic market, its low labor costs (despite recent reports of rising wages) and its existing ecosystem of components suppliers.

Taiwan continues to be the dominant player in the ODM space, says Wu, "in quite a few product categories, ranging from laptop computers to handhelds to cell phones, motherboards and graphic cards." However, analysts do see Taiwanese ODMs moving more of their manufacturing to lower cost countries such as China or even India as a result of labor costs in Taiwan, which are now three-and-a-half to four times that of China.

On the semiconductor front, says Vaswani, Taiwan has "undisputed leadership in chip fabrication with companies like TSMC [Taiwan Semiconductor Manufacturing] and UMC [United Microelectronics] having almost half the Asian market and continuing to stay strong." In-Stat reports that Taiwan, after years of building up its DRAM and foundry capacity, has the highest density of fabrication facilities in the world.

Korea is "strong in memory chips and will continue to stay so," says Vaswani, "but the memory market is currently undergoing some consolidation. The margins are lower in DRAM" than in other types of chips, he says, "so it's very difficult to sustain for any of the players unless they have scale and all their customers in place."

The country is also seeing new developments on the microprocessor front. Early in 2006, Photronics announced plans for a facility in Korea to support the development and volume production of advanced photomask technologies required to produce semiconductors on 65-nanometer, 45nm and smaller production processes.

Samsung, in addition to dominating the memory chip market, is also boosting capacity of the large displays consumers crave in TVs. In spring 2006, it announced plans to invest $751 million in a new production line at an existing plant in Ulsan that will produce 3 million 42-inch PDP screens a year, bringing the company's total capacity to 7.32 million units per year. Competitor Lucky Group is also moving forward in display technology. A joint venture between LG and Royal Philips Electronics claims to be developing a 100-inch LCD display, the largest yet.

However, Krysiak says that over time, Korean consumer electronics manufacturers will come

Continued on page 28

Robert Krysiak
STMicroelectronics

Continued from page 27

Jeffrey Wu
iSuppli

under pressure to move to China for manufacturing. He also predicts that some Korean semiconductor firms, while keeping fabrication operations in Korea, will move their more labor-intensive assembly and test functions to China.

India is known more for its call centers and other services than for manufacturing, but that may be changing. The Indian manufacturing market was only $800 million in 2005, but Vaswani predicts that it will grow to $2.3 billion by 2009. Its growth has been encouraged by the government's establishment of "electronic hardware technology parks" offering incentives such as duty-free import of capital goods, raw materials and components. So far, Indian companies are limited "to some of the more basic projects, like disk drives and memory modules," says Wu, "products with a low barrier to entry with commoditized design."

Much of the EMS growth in India is driven by foreign companies setting up plants to manufacture mobile phones. As with computer components, much of the new capacity is currently aimed at filling booming domestic demand in India. "You've got margins on the low end as low as $2 to $3" per phone, says Vaswani, so low they would be wiped out by import duties if the phones weren't made locally. But in several years, he sees global giants such as Nokia and Samsung using their new Indian assembly facilities for export as well.

The move by major contract manufacturers into development and design may mean opportunity for India. "EMS providers planning to evolve into ODM players can leverage India's low-cost engineering pool to develop design and R&D centers," according to a May 2005 iSuppli report titled "Outsourced Electronics Manufacturing in India." The presence of chip design centers run by giants such as Intel, Texas Instruments and IBM, as well as local facilities run by electronic design automation firms, provides incentives for EMSs looking to evolve into ODMs to also locate product design centers in India, the report says. It cites D-Link and Flextronics as among the "global EMS players that have already initiated efforts to evolve into significant ODM players through Indian expertise."

Western companies such as Texas Instruments have run semiconductor design operations in India since 1985, a trend that has accelerated since the dot-com crash, says Vaswani. But it was only in early 2006 that SemIndia, a consortium that will receive 25 percent of its funding from the Indian government, announced plans for India's first assembly-test-mark-pack plant. But Vaswani doesn't see India becoming a semiconductor powerhouse to rival Taiwan, for example, because it lacks the reliable supplies of clean water and power needed for semiconductor manufacturing.

Wu says Indian manufacturers will need to significantly increase their technical skills before they are able to climb the value chain by offering service and support as well as product manufacturing. At this point, he says, "they're just trying to develop and grow their overall business model." Vaswani, however, sees brighter prospects for Indian-based services, based on the region's success in back-office service and support operations.

Singapore is headquarters to Flextronics and Venture Manufacturing, but each of those EMS vendors does much of its actual assembly work in nearby, lower cost countries, says Wu. While each is a giant player, neither saw much revenue growth in 2005, says Wu. "All of the contract manufacturers, whether they are Taiwanese or Singaporean, are shifting their manufacturing capacity from their home countries to lower cost countries such as India and China," he says.

Singapore is also home to Chartered Semiconductor Manufacturing, which operates five fabs there. But Vaswani says Chartered has had trouble competing with Taiwanese giants such as UMC and TSMC because the island state "doesn't have that low-cost advantage." Even the major disk drive and storage vendors, which have long had major operations in Singapore and Malaysia, have been moving manufacturing into lower cost countries in the region, he says.

Nevertheless, Singapore's Economic Development Board claims that Singapore produces 10 percent of the world's semiconductor wafers, is home to four of the world's top 10 "fabless" IC design companies and produces 25 percent of the global market for retail point-of-sale impact printers.

Continued on page 36

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DSP	1.11	Under development
Microcontrollers	3.64	0.38
Microperipherals	5.33	Very few
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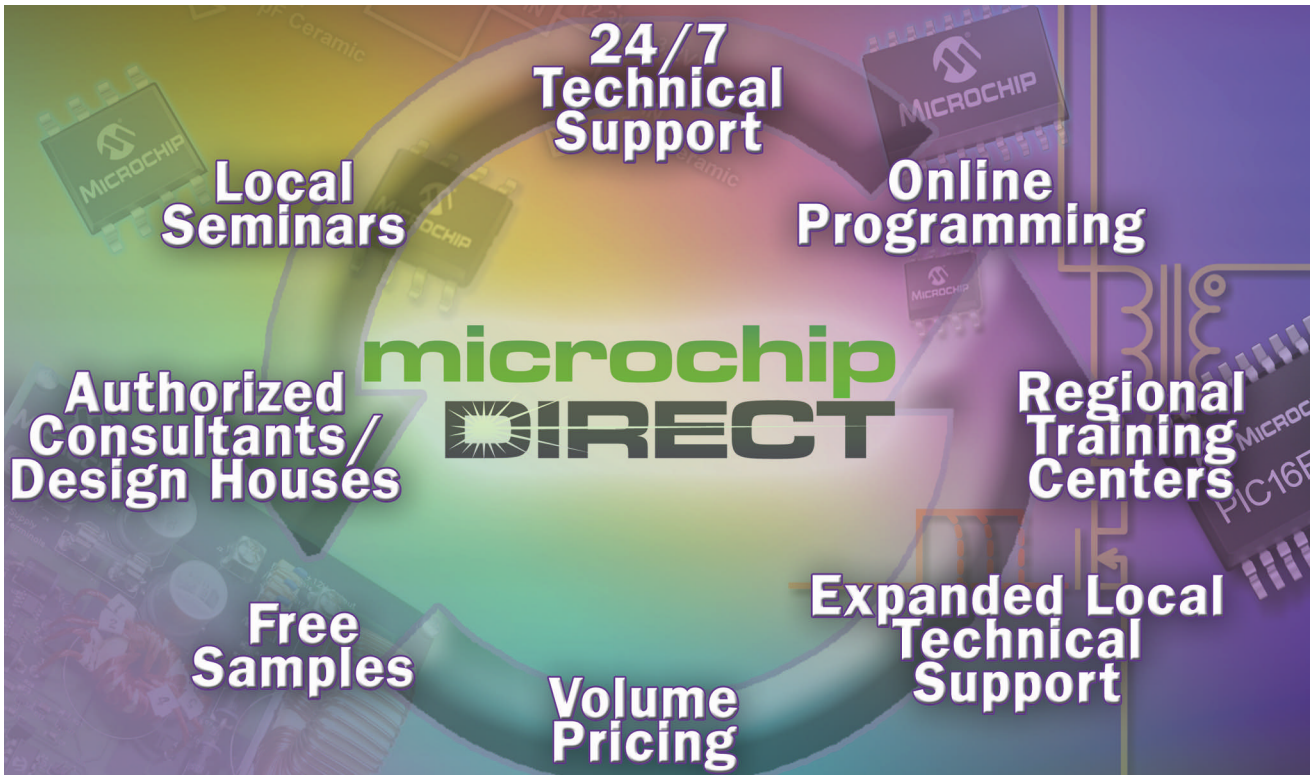

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Transition Under Way

EUROPE *ekes out* growth

By Drew Wilson

Europe is one of the global semiconductor industry's table legs. Recent figures suggest it needs to have a little paper crammed underneath it.

From a market growth perspective, Europe has come up short. Last year, the European semiconductor market was worth $40 billion, up 1.7 percent, whereas the world market grew 8.2 percent, according to U.K.-based semiconductor research firm Future Horizons. In 2006, Europe is expected to grow 17.9 percent, whereas the U.S. market is forecast to grow 21 percent and Asia 28 percent. The world chip market is expected to grow 20 percent, to $293 billion, according to Future Horizons.

Future Horizons, which has a track record of fairly accurate market predictions, has issued the most optimistic forecast among research firms. CEO Malcolm Penn argues that the three key variables for the worldwide semiconductor industry—the economy, unit demand and wafer fab capacity—have aligned to drive growth.

Out of Capacity

Worldwide capital expenditures are expected to see a 30 percent increase over those of 2005. According to Penn, vigorous, late-second-half spending will occur when companies realize that they are out of capacity. "It takes two quarters for equipment to come onstream," he says. "That's why this year will remain strong—companies haven't spent the money. Providing that the economy holds up, capacity will get tighter."

Deutsche Bank has issued more-modest predictions, forecasting an increase in semiconductor industry capex of 2.3 percent, to $48.4 billion in 2006. Three-hundred-millimeter capacity additions are projected to increase 1 percent in 2006—memory making up half of that—with 31 projects slated for start, expansion or upgrade.

Deutsche Bank forecasts global chip market growth at 11 to 13 percent. Europe's three chip makers—STMicroelectronics, Philips Semiconductor and Infineon Technologies—will converge around the lower end of this range, according to Nicolas Gaudois, director of semiconductor equity research at Deutsche Bank.

Europe's semiconductor companies are in the throes of fundamental change. STMicroelectronics last year changed CEOs and is busy reinventing itself to fit the realities of a consumer-oriented semiconductor industry, analysts say. "With the number of new-product launches, the realigned company should be coming close to the industry growth rate," Gaudois says. "In general, STMicro and Philips Semi underperformed industry growth for the past four years."

STMicro also hopes to benefit from its three-year-old NAND flash memory tie-up with Hynix Semiconductor. "STMicro will use these NANDs for stacked memories and will address the same market for NOR flash: wireless," Gaudois says. "From a technology standpoint, STMicro should also benefit from the fact that Hynix is going after the mass market on the side."

According to IC Insights, the joint venture, called Hynix ST Semiconductors, may pose a threat to Toshiba for the No. 2 NAND flash memory position in 2006.

Analysts previously questioned STMicro's concentration on key customer Nokia, which accounted for 17 percent of the chip maker's revenue in 2004. That has increased to 24 percent, Gaudois says. However, STMicro's revenues from

Nokia are up 30 percent year-over-year, whereas the rest of the business is flat, according to Gaudois. "They've increased content at Nokia but also grown with the handset maker."

Philips Semiconductor (which specializes in making chips used in cell phones, TVs, autos and RFID) announced plans to split from parent company Philips Electronics. The idea is to get large. It has several options, including merging, being acquired, acquiring other businesses or launching an IPO. "Philips will be in better shape to look at M&A, particularly on the manufacturing side," Gaudois says. "Independence from the group is a good thing, but ties will remain for some time, because IP at the source is generated by the Philips group."

Europe's other chip maker, Infineon, is in a more difficult situation. After reporting a $376 million net loss for FY2005, management announced the spin-off of its memory division into a separate entity called Qimonda. "It came to terms with the fact that the logic business and the DRAM business have very few synergies with each other," Gaudois says.

Memory products contributed 44.4 percent of Infineon's FY2005 revenues. The remainder of the company will supply logic and system chips and will increase use of foundries, pursuing a fab-lite strategy.

Good flying wind

The memory division, given a good flying wind, is expected to thrive. "The other part will have a tremendous set of problems," Future Horizons' Penn says. "If Infineon splits, it will drop out of the top 10 and be a second-tier player in a mishmash of other markets, apart from smart cards [where it is a leader]."

Moreover, the remaining part of Infineon will focus on the industrial, automotive and communications markets. Because it doesn't play in the consumer market space, which is widely considered to be the growth market, it is condemned to lose market share, he adds.

Jean-Philippe Dauvin, chief economist at STMicroelectronics, believes that the global chip market will be up 8 percent whereas Europe will grow by 2 percent. Europe's chip market drivers will be automotive electronics, communications and base stations. "These are soft drivers," Dauvin says. "Europe is moving—not very fast, but moving. We are ahead of Japan."

One strong industry sector in Europe has been automotive. Europe is leading the world in automotive electronics all the way down the chain. The center of excellence is in Germany, led by the firm Robert Bosch in Stuttgart. But automotive won't take Europe far in the near term. The sector, close to $16 billion in 2005, accounts for a mere 7 percent of the overall semiconductor market, according to research firm Strategy Analytics. Europe holds little more

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than one third of that 7 percent. Moreover, sluggish vehicle sales could slow the automotive electronics market in 2006.

A swing factor for Europe is economic recovery in Germany and France. In 2005, Germany, Europe's largest economy, recorded an unemployment rate of 12.6 percent, its highest since World War II. France has seen a spate of protests and strikes due to attempted modernization of its economy. Dauvin calculates that these two engines need 2.5 percent GDP growth on average in order to register upward movement in the overall electronics market in Europe. However, Germany and France are expected to show GDP growth of only 1.8 percent and 2.1 percent, respectively, according to the Organization for Economic Cooperation and Development (OECD).

On the end product side, the picture is a bit brighter. Consumer electronics and information and communications technology (ICT) are showing clear growth, despite the slowdown in Europe's largest economies.

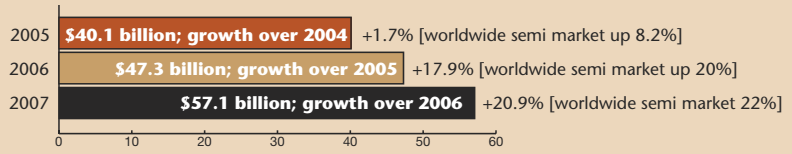
Europe's total consumer electronics market in 2005 was $65.7 billion, up a record 10 percent, according to the European Information Technology Observatory (EITO), in Frankfurt. In 2006, the market is expected to grow 7.2 percent, to $70.4 billion, according to the EITO. Growth is strong but concentrated in a few sectors: flat TVs (both LCD and plasma, as digital television rapidly replaces traditional TV), MP3 players, DVD players and game consoles.

In ICT spending, Europe leads the world (*see chart*), accounting for more than one third. The ICT market, slated to grow 3.2 percent, to $816 billion, in 2006, serves as a benchmark for Europe's market health. "You cannot separate ICT any longer from other industries, because it has a lot of impact on other areas," says Carola Peter, EITO's managing director.

IT security, regulatory compliance that involves business infrastructure upgrading, the shift from the desktop to a mobile environment and e-government have all been growth drivers for ICT.

The countries that entered the EU in 2004 are showing the highest ICT growth as they continue to upgrade their IT and telecom frameworks. "There's still a boom going on there," Peter says. "The markets are not saturated, and they have higher demand in more basic areas." However, ICT market growth is expected to decline until 2007, when it will reach 2.9 percent growth.

Europe's Semiconductor Market



Source: Future Horizons

Perhaps Europe's biggest opportunity lies in the accelerated growth of broadband penetration, both wireline and wireless. Europe's broadband buildout is the most robust in the world, according to the EITO. The compound annual growth rate (CAGR) is 29 percent from 2004 to 2008, compared to 16.6 percent in the United States and 8.1 percent in Japan.

Europe's Information and Communications Technology Market

	2005	% of worldwide ICT market	2006
Europe	$791 billion	33.8%	$816 billion, up 3.2%
U.S.	$654 billion	28%	$680 billion, up 3.9%
Japan	$344 billion	14.7%	$349 billion, up 1.1%
R.O.W.	$548 billion	23.5%	$586 billion, up 6.3%

Source: European Information Technology Observatory

Manufacturing Dynamics

The contract manufacturing landscape underscores the continuing shift of production from West to East. High-volume manufacturing seems to be reviving on Europe's periphery, away from the comparatively high taxes and labor costs in the West, according to Scotland-based MHM Business Development Services.

Michael Hannon, MHM consultant, says the Western Ukraine area, including Romania and Bulgaria—both expected to enter the EU in 2007—are pulling in production. Flextronics runs a plant in Western Ukraine, and Foxconn is rumored to be looking there, he says. Celestica followed Solectron into Romania. In Bulgaria, Videoton and Epiq are running plants. "Eastern Europe is giving China a run for its money," Hannon says.

MHM sees a three-tier Europe evolving, with R&D and high-mix/blow-volume in the West and low-cost assembly work in the East. Central Europe—Hungary, the Czech Republic and Poland—sits between the two regions and may act as a systems integration center.

Semiconductor manufacturing is another issue altogether. Future Horizons' Penn says Europe's share of the world market has been eroding. Europe represented 17.4 percent of worldwide market share in 2005; 17.1 percent is expected in 2006 and 16.9 percent in 2007, he says.

Europe's population grew 20 percent, to about 450 million, when the Union added 10 new countries in 2004. The raw measure of a larger population would make Europe appear to be increasing its semiconductor market share. However, the far more accurate per-capita figures are unknown. "Even if Europe's growth looks good on its face, Europe is actually showing declining share," Penn says.

His position reflects a debate in Europe about the direction of its semiconductor industry.

Europe imports more chips than it produces, according to the European Semiconductor Industry Association (ESIA) in Brussels. Europe's chip market is close to 20 percent of the world market, but semiconductor production is 12 percent of the world's wafer fab capacity.

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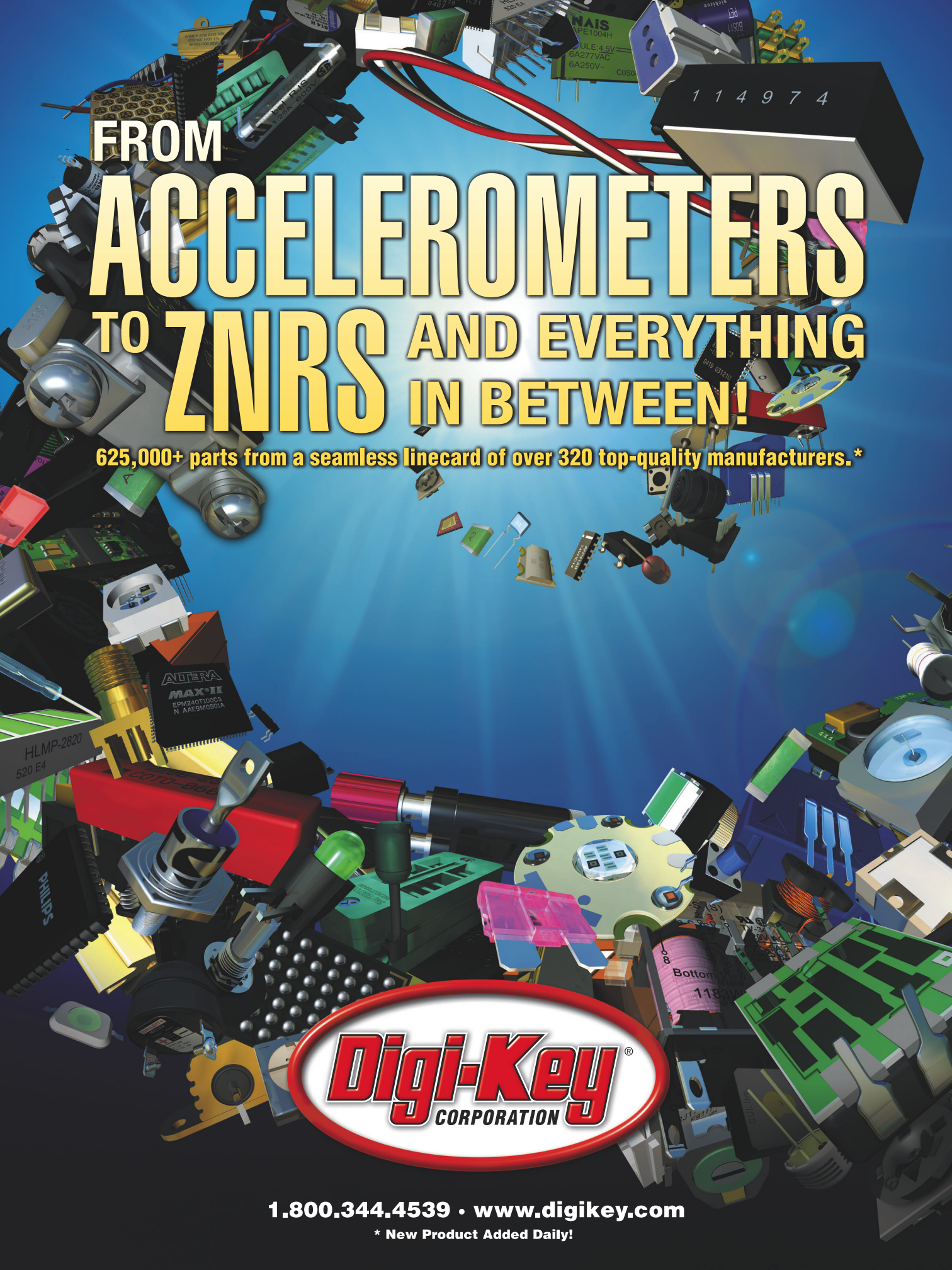
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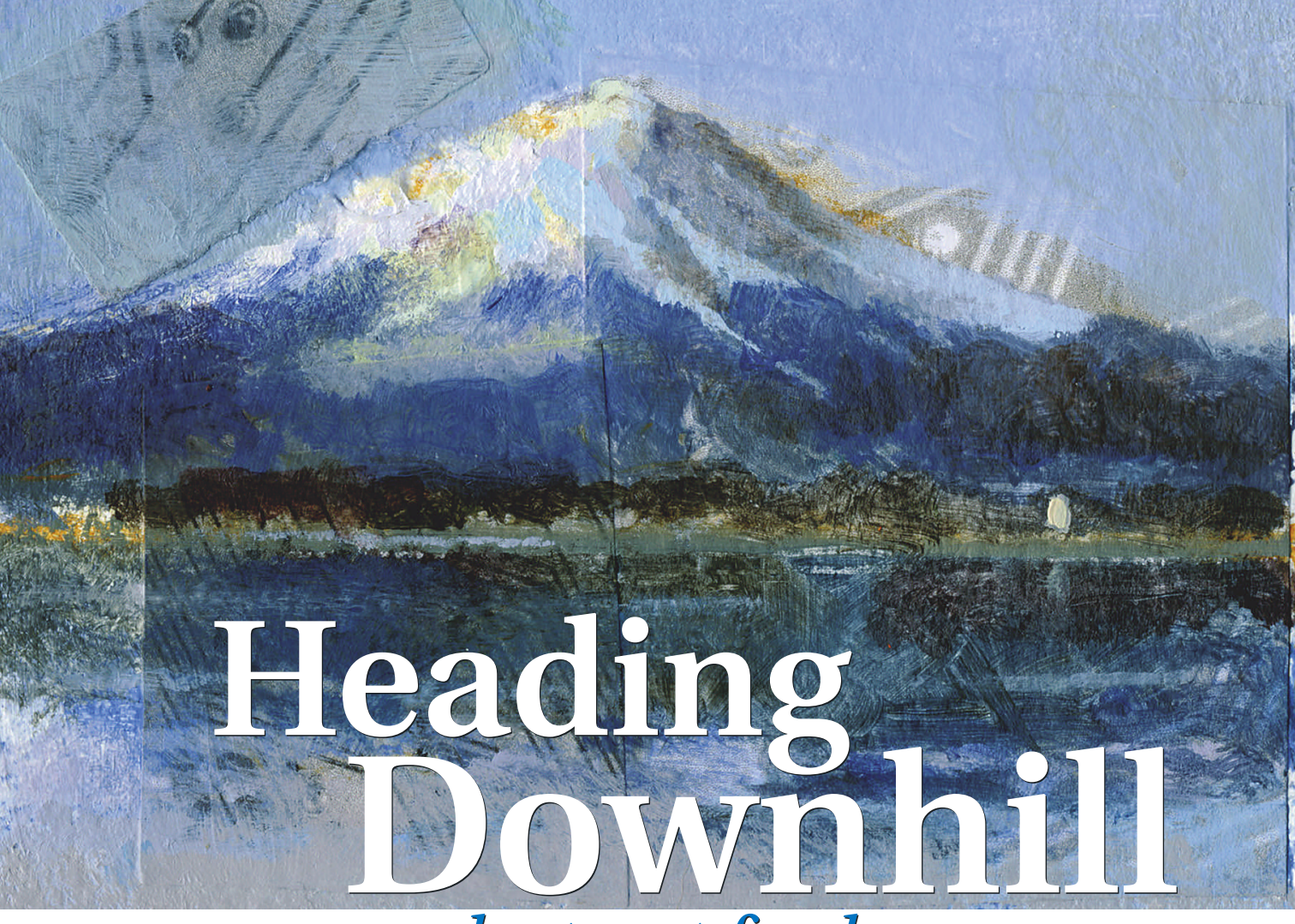

Heading Downhill

but not for long

By Akira Minamikawa

In 2005, the personal computer and cell phone markets in Japan were better than initially expected, since the global economy has remained strong since 2004. The global economy usually affects the Japanese economy due to its large export business. In 2006, the Japanese economy is expected to experience a recession, according to Tokyo research firm, Digital Garage. This will mirror a recession in the overall Asian economy due to higher oil prices, a decrease in PC sales in advanced countries and reduced housing prices in the United States, all factors that point to a global slowdown. Digital Garage expects the recovery to emerge in the second half of 2007.

In the Japanese PC sector, aggressive personal consumption will continue, while corporate consumption in Japan will decrease in the second half of 2006. Digital Garage estimates personal consumption will show 9 percent growth in unit shipments and 2 percent growth in sales revenues. Total PC consumption in 2006 is expected to slow down somewhat and low-priced notebook PC sales will be stable due to exports to the Brazil, Russia, India and China (BRIC) countries. DRAM chips will not grow in memory capacity base in a single PC due to lower priced PCs, leading to excess supply in the second half of 2006.

In the Japanese cellular phone sector, unit shipments will grow 9 percent and revenues will grow 1 percent in 2006, according to Digital Garage. The average unit selling price will be down due to the rise in $50 phones available on the market. Supply of mobile RAM will be tight due to an increase in cellular phones with DRAM and NAND flash memories.

In the flat-panel TV sector, U.S. sales will be down slightly, but total worldwide sales will increase 43 percent in unit shipments and 33 percent in revenues in 2006, according to Data Garage. Because flat-panel TVs will be required to feature digital TV tuners in 2006, replacement demand will be boosted. Also, the reduction in TV prices will help drive growth. Chinese manufacturers' planned mass production of flat panel TVs may further drive down prices. These manufacturers will procure the second-ranked flat panel from Taiwan and Korea and produce TV sets priced at half those made in the Japanese market.

In the music player sector, NAND flash memory demand rose rapidly in 2005 due to growth in sales of MP3 players. MP3 players compete to some degree with cell phones, but will be compatible with each other

because of the battery life of mobile phones. NAND demand will increase because hard-disk-drive (HDD)-less or hybrid PCs will be marketed at the end of 2006.

The three-month Data Garage average ratio shows a peak in book-to-bill ratio, suggesting a future downturn. The DG ratio is a three-month advanced index of semiconductors and components. According to the DG ratio, the semiconductor and component markets will trend downward in the third quarter this year.

In the semiconductor sector for PCs, the first quarter of 2006 showed positive growth compared to the previous year, according to Data Garage, and a slight reduction for the month of February compared to the same period last year. That is due to the seasonal downturn and excess inventory of motherboard manufacturers. The situation will move upward again.

The market for chips for HDD drives will stay strong in 2.5-inch drives. The market for chips for printers will gradually continue to recover. In the market for cellular phone chips, sales in the first quarter were up compared to the previous year and will turn upward in February compared to the same month the previous year.

In the worldwide consumer electronics sector, chip sales will grow by over 10 percent in 2005 compared to the previous year. Globally, there is strong demand for chips to go in LCD TV and plasma TV sets. Demand for digital cameras is likely to grow as well, according to Digital Garage, but at a lower rate. The inventory of DVD recorders seems excessive. Portable music players are now in an adjustment stage, but their growth rate is higher than last year. For the automotive market, demand for chips continues to grow compared to the previous year. Demand for air conditioner chips is also strong. ■

Akira Minamikawa is an analyst for Data Garage*, based in Tokyo.*

One Japanese View: "Never Outsource"

By Margery Conner

Ask Takeo Suzuki, president of Densei-Lamda, a Tokyo manufacturer of power supplies, about how to compete with the Chinese, and he'll tell you simply, "Don't outsource. Never outsource." This blunt contradiction of what is accepted wisdom in the United States comes from years at the helm of the No. 4-ranked global power supply manufacturer, competing with lower priced manufacturers, both in China and Taiwan.

"The U.S. has been pursuing outsourcing for the past generation, and look what has happened to its competitive advantage in manufacturing -- it's disappeared. You can't keep your manufacturing know-how if you lose the actual manufacturing," says Suzuki.

Because the Japanese power-supply market has the highest standard for quality, Lambda has focused on high-quality design and manufacturing. That means Lambda can't compete in consumer markets, which won't pay a premium for quality. Instead, Lambda goes after markets that will pony up, such as the industrial/medical market, with customers like Ford and Siemens Medical. Lambda's parent company, TDK, focuses on telecomm applications, with customers like Nortel and Nokia. Contrast these markets with low-end segments serviced by Taiwanese power supply powerhouse Delta, such as AC adapter/chargers, which will not justify Lambda's premium. Even within China, Lambda is a prime supplier of industrial power supplies.

True, Lambda does take advantage of China and Taiwan's lower manufacturing costs, but only when Lambda owns the factory outright. Suzuki says, "We hear of our competitors being cut out by their contract manufacturers when a higher volume customer comes along. Because we own our factories overseas, that's not a problem for us."TDK's purchase of Lambda last October is an indicator of its management's commitment to vertical integration. "Before TDK bought us we were competitors," says Hiroyuki Yashiro, chief technology officer for Densei-Lambda. "We could not get details on their newest ferrite cores, an important element of new power supply designs. Now that we are part of TDK, we have access to their ferrite developments a year in advance."

Looking at other general manufacturing companies within Japan, Suzuki points to companies like Toyota, Canon and Fuji Film, which have tried outsourcing and are pulling their manufacturing back inside Japan. "As the economy heats up and excess manufacturing supply disappears, companies find they must control their own manufacturing sources." He points to automation as the key. "Our factory costs can be competitive. The Chinese might have 20 workers doing what we have one do."

Before you dismiss Suzuki's anti-outsourcing, pro-verticalization philosophy as hopelessly old-fashioned, consider TDK's recent announcement of its new DC-DC converter for hybrid cars, used both in the Honda Civic and Ford Escape hybrid models. The converter relies on a new ferrite core-based transformer that TDK's ferrite group developed based on requirements from its power supply group. TDK's ability to develop the ferrite core with characteristics that remain constant over the extreme temperature range required by automobiles: -70 degrees C to +140 degrees C. This technical innovation coupled with manufacturing and packaging capability put TDK in the unique position of being able to combine power supply design, magnetic components technology and manufacturing ability. Just try that level of innovation when you outsource your engineering, manufacturing and R&D. In the words of Lambda's Suzuki: "You must own your factories and own your technology know-how."

Margery Conner is a technical editor at EDN.

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Top 10 Chinese IC Design Houses in 2005

2005	2004	Company	(in millions) Revenue
1	3	Action Semiconductor	156.60
2	5	Vimicro	95.67
3	4	CEC Huada Electronic Design	79.79
4	2	Hangzhou Silan Microelectronics	75.44
5	1	Datang Microelectronics Technology	71.28
6	9	SHHIC	46.49
7	7	Hangzhou Youwang Electronics	31.21
8	6	Shaoxing Silicore Technology	29.14
9	N/A	Tongfang Microelectronics	28.91
10	7	China Resources Semico	28.43

Source: China Semiconductor Industry Association

Leading fabless semiconductor company Xilinx has announced plans to invest as much as $80 million to expand its manufacturing capacity and operations in Singapore.

The board also pointed to an $850 million investment in new manufacturing capacity by hard disk media manufacturer Showa Denko and a $170 million expansion to a glass magnetic disk production plant by Hoya Magnetics. Overall, the board claims that Singapore supplies 25 percent of the world's disk media and that its manufacturing capacity is expected to double by 2008. (Staking out another growing, although nonmanufacturing, market, the board also pointed to the launch of Singapore facilities for a number of gaming and animation companies.)

Needed: Customer Knowledge

One pressing need for both EMS and ODM companies, Vaswani says, is to gain a better understanding of the needs of not only the OEMs they sell to, but also the consumers that buy the finished products from the OEMs. "Most of the time, these players...don't have a very good idea of the road map of the OEMs, so they don't know how much demand is coming. They end up, many times, with a glut of inventory," he says. "You need to have a very clear road map of the customer, in terms of demand, and also have an idea of what the end customer needs."

Whatever the strengths, or weaknesses, of individual companies or individual regions are, manufacturers of all stripes "need to create a position not just of low-cost manufacturing, but of service and quality," Vaswani says. "Tomorrow, they're going to have competition from Mexico and Russia, not just Asia." ■

Robert L. Scheier is a contributor to Electronic Business.

EUROPE *Continued from page 32*

The ESIA's concern is that Europe will host fewer wafer fabs than other world regions, resulting in diminished potential for semiconductor innovation, according to Hans-Friedrich Buhner, senior director of relations management at Infineon and chairman of a task force that wrote a competitiveness report. He argues that R&D is tightly connected to the leading-edge process technologies in the fab.

Yet Europe attracts less than 10 percent of capacity investments worldwide, he says. A fab in China, Korea or Malaysia will generate net income 220 percent higher over a given period than the same fab in Germany, with little difference across European countries, according to the report. The main difference is that Asia has attractive investment incentives that Europe lacks.

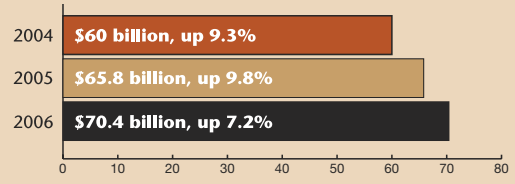
The conventional wisdom that as long as the intellectual property stays in Europe, the flight of manufacturing is tolerable is mistaken, sources say. "IP goes where the product is, if for no other reason than shortened design cycles," Penn says. "Chinese and Indian talent is just as good as European talent, and it is only a matter of time before R&D goes there. Then what is Europe left with? Theoretical scientists and philosophers?"

Deutsche Bank's Gaudois disagrees, adding that system and process design can remain separate without sapping Europe's innovation. "The real issue for European companies is whether they retain the market presence and relationships they need in order to drive innovation and hold margins in the long run," Gaudois says. "For many of them, the answer is to use fabs in Asia to avoid the cost issue in Europe or to go fab-lite."

STMicro's Dauvin also believes that Europe is not in danger of losing some vital strengths and becoming a follower in semiconductors. He asserts that it has held a leading position in dedicated (that is, non-DRAM) ICs over the past five years and that this is not under threat. Dauvin argues that all regions have seen a shift of chip manufacturing to Asia while the global chip industry's annual growth has dramatically slowed. His calculations show that, on average, the market grew 14 percent annually from 1995 to 2005. Going forward, he puts the best-case scenario for annual growth over the next 10 years at 8.5 percent.

The semiconductor business is also becoming more consumer-oriented, increasing price pressure throughout the supply chain and shaking up traditional models. ■

Europe's Consumer Electronics Market*



Source: European Information Technology Observatory
**Figures for Western Europe*

Drew Wilson is a freelance writer based in Berlin.

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Philips Nexperia Mobile Solutions. A mobile phone that can buy tickets to the game. A mobile phone that allows you to watch the game when you can't get to the stadium. A mobile phone that takes a picture of your friend coming to terms with his team's loss and shares it with your other friends. People buy their mobile phones today expecting much more than just a mobile phone. That's why you need an adaptable technology solution that can be tailored and changed as fast as your consumer needs. With Philips Nexperia Mobile Solutions, you'll find flexibility in platform design to customize your handset offering for different features and markets, and a total system approach that enables easy porting of various software applications. We address every type of GSM/GPRS/EDGE/UMTS/TD-SCDMA mobile phone, and provide expertise in value-added features such as connectivity, security, broadcast and multimedia. So no matter what's next in mobile phones, Philips will help you design it.

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MARKET LEADERS

Our 2006 Market Leaders determines the leaders in 16 product categories. Each includes a market overview and an accompanying chart comparing 2004 to 2005 revenue for the top 10 companies.

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A Struggling Intel STAYS ON TOP

By Debra Bulkeley

Stephen L. Smith, Intel

How hard will AMD continue to nip at Intel's heels in the microprocessor arena?

Comparing this year's top 10 microprocessor leaders to last year's shows how little movement there was in the list. After all, Intel is still No. 1, with a commanding 82 percent of the microprocessor market, according to 2005 market-share numbers from iSuppli. Advanced Micro Devices remains a distant second with 11 percent, followed by Freescale Semiconductor with 2.8 percent and IBM Microelectronics with 2.3 percent (see chart).

But the revenue numbers don't tell the whole story.

While AMD is second to Intel, the former racked up a 46.5 percent increase in its 2005 revenue compared with 2004 (Intel had a 12 percent increase for the same period and has announced big spending cutbacks). Indeed, AMD was the fastest growing semiconductor company in the world, according to the May issue of *Electronic Business* magazine. Intel was No. 11. And AMD gained market share over Intel last year when it introduced its Opteron chips, for the server market. Designed to consume less powe, Dell recently became an Opteron processor.

The two companies have competed to be the first to market with a dual-core processor. Intel was first with a dual core for PCs, and AMD was first to bring dual-core chips to servers. Now both companies are preparing to introduce dual-core processors for the mobile market. AMD will launch the Turion 64 X2 mobile technology in the second quarter of 2006; Intel will be ramping in volume its mobile Merom processor in the third quarter of 2006.

Intel unveiled its new Core microarchitecture at the Intel Developer Forum in March, touting it as a new foundation for Intel architecture-based desktop, mobile and mainstream server multicore processors.

The Core microarchitecture offers dual-core products, each targeted to a specific platform: mobile, server and desktop. The product—Woodcrest, Conroe and Merom—will be ramping in volume in the third quarter of 2006, according to Stephen Smith, vice president and director of Intel's desktop platform operations.

One of the features Smith emphasizes is the technology's energy-efficient performance. For example, he claims that the server processor, Woodcrest, will have an 80 percent improvement in performance and a 35 percent reduction in power compared with Intel's high-end dual-core 2.8-GHz Xeon processor. The desktop product, Conroe, promises a 40 percent improvement in performance and close to a 40 percent reduction in power, he said.

While the new products will improve performance in each market segment, perhaps the biggest impact will be felt in the mobile market, since dual core is already available on the desktop, Smith says. Merom is expected to deliver a more than 20 percent

Continued on page 83

Top Ten Semiconductor Companies

(Millions of Dollars U.S.)

2004 Rank	2005 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	Intel	28,116	25,093	12.0%
2	2	Advanced Micro Devices (AMD)	3,806	2,598	46.5%
3	3	Freescale Semiconductor	951	916	3.8%
4	4	IBM Microelectronics	781	328	138.1%
5	5	Samsung Electronics	109	144	-24.3%
6	6	Marvell Technology Group	78	65	20.0%
8	7	VIA Technology	67	60	11.7%
9	8	Fujitsu	53	53	0.0%
7	9	NEC Electronics	51	60	-15.0%
14	10	Beijing Vimicro Microelectronics Co Ltd	46	14	228.6%
		All Other Companies	130	125	4.0%
		Total	**34,188**	**29,456**	**16.1%**

Source: iSuppli

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DSP Platforms TAKE CENTER STAGE

By Robert Cravotta

Greg Delagi, TI

Digital signal processing (DSP) is a critical enabler for cell phones, broadband modems, digital base stations, mobile handsets, digital cameras, as well as audio and video applications. The amount of processing that DSP systems are able to perform in real time continues to escalate exponentially. As signal processing performance increases, so does the complexity of the silicon and software that enable the increased processing.

As a result, silicon providers and their partners are changing how they develop, offer and support their products. Long gone are the days when a company could offer a sample chip and a data sheet or application note with instructions for how a designer could hook up to the processor and start working. Semiconductor companies today offer more complete support with their silicon products by including developments tools, sample software, frameworks, access to application-specific intellectual property (IP), reference designs and design services.

According to iSuppli, the 2005 DSP market was larger than $7.5 billion. Texas Instruments' revenue for DSP products accounts for more than a 50 percent share of that market. Freescale is the second largest DSP vendor, and its 2005 market share is less than one-quarter that of Texas Instruments. While chips for cell phone basebands continue to represent TI's largest DSPsegment, the company recently moved to be the leading player in the emerging video and audio markets with the release of its DaVinci platform.

Wrapping a platform around a silicon offering is not unique to TI, but the DaVinci platform represents a higher support bar vs. previous platform offerings as an approach for how the semiconductor industry can reduce the entry barrier for designers of complex applications, such as video. The product and support model for the platform represents a hybrid approach to delivering basic capabilities and compatibility with room for custom functions while supporting standard configurations that include vertical or application-specific optimization.

Greg Mar, worldwide DSP SoC platform manager at TI shares that "our earlier platform offerings still required the designer to be an expert to harness the promised performance of the system. The DaVinci platform benefits from the lessons learned from earlier offerings by simplifying the complexity to realize the performance promises while maintaining a system that is open enough for expert signal processing developers to fully harness the power of these systems — especially in directions we never imagined."

Greg Delagi, vice president and manager of Worldwide Digital Signal Processing Systems at TI points out "DaVinci is a continuation of a trend on how to support designers. It costs tens of millions of dollars to bring new technology to market, and we feel this approach is the fastest way to meaningfully get the technology into the hands of developers." He adds it is insufficient just to deliver the technology. The vendor must bring the sales force, the technical support force and the third party support up to speed before putting the technology in the hands of the designers. Platform offerings are including more application software, more system integration, design services and licensing options than before.

What is meant by the expression "we offer a complete solution" is a moving target in the semiconductor business. Invariably, it has meant the silicon provider provides more software, design examples, reference designs and IP options than before. To remain a leader in this market requires more than just delivering on raw technical specifications, it requires the market leaders to figure out how to offer more capabilities while keeping a hold on the complexity designers face. The day of the platform as a means for abstracting that complexity finally appears to be upon the market. ■

Top Ten DSP Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change	Percent of Total
1	1	Texas Instruments	4,450	3,875	14.8%	58.8%
2	2	Freescale Semiconductor	1,037	1,004	3.3%	13.7%
3	5	Agere Systems	572	519	10.2%	7.6%
4	3	Analog Devices	442	570	-22.5%	5.8%
5	4	Philips Semiconductors	424	533	-20.5%	5.6%
6	6	Toshiba	379	347	9.2%	5.0%
7	7	DSP Group	187	158	18.4%	2.5%
8	9	Fujitsu	27	30	-10.0%	0.4%
9	8	NEC Electronics	27	40	-32.5%	0.4%
10	12	Mindspeed Technologies	8	7	14.3%	0.1%
		Other Companies	16	30	-46.7%	0.2%
		Total:	**7,569**	**7,113**	**6.4%**	**100%**

Source: iSuppli

Robert Cravotta is a technical editor at EDN *magazine.*

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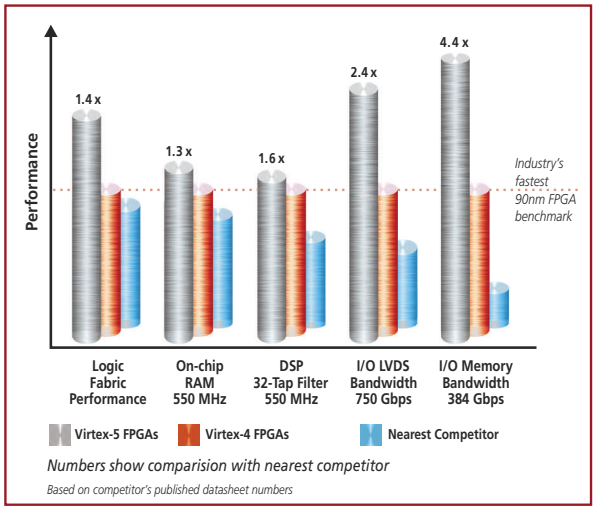

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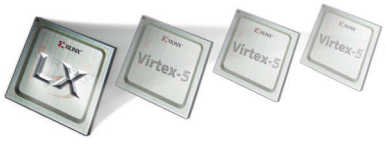

The Ultimate System Integration Platform

Dynamic Duo Still Dominate PROGRAMMABLE LOGIC

By Howard Baldwin

Wim Roelandts Xilinx

It was a wild ride in 2005 for the programmable-logic device (PLD) market. Some companies in the segment lost money even as the overall semiconductor market was growing. A few lucky ones in the top five increased revenues, but only by single digits. Xilinx retained its position at the top of the heap, with $1.6 billion, even though longtime competitor Altera, with revenues of $1 billion, outpaced its growth rate, 7.6 percent to 3.7 percent.

There's a big drop-off after those two, which represent 83.5 percent of the PLD market, according to iSuppli. The others in the top five—Lattice Semiconductor, Actel and QuickLogic—constitute only another 13 percent of the market.

There were bright spots,of course—the competing technology called structured ASICs said to combine the best features of ASIC and FPGAs lost one of its stalwarts: LSI Logic announced that it was ending what it called its "platform ASIC" development, as part of new CEO Abhi Talwalkar's reorganization of the company.

PLDs seem to have vanquished structured ASICs, simply by catching up to them. PLDs can now offer the part-standard, part-customized capability that made the concept of structured ASICs so compelling. "Look at what all the leading vendors are doing in terms of IP," says Jordan Selburn, principal analyst in iSuppli's Core Silicon group. "It's not just 'Here are 500,000 gates; go have fun developing something,'" he says. "They're still selling standard products, but they're making them a better fit for someone who wants a custom solution." The top vendors are giving customers options in terms of digital signal processing capability and even processors themselves.

For Selburn, though, the structured ASIC market remains "a very interesting can of worms," one with more questions than answers. He's not sure LSI's departure from the market is a reflection more of structured ASICs or of LSI's shift. But he notes that in the fourth quarter, he saw the revenues flattening for Altera's HardCopy technology, which he puts into the structured ASIC category.

Add to that, says Selburn, the possibility that structured ASICs aren't getting the same advantages from advances in process technology as other devices—especially PLDs. "As Moore's Law marches ahead, it helps other kinds of semiconductors," he says. "PLDs continue to get smaller, which is important for them, and faster, which opens up new applications, and their power needs are getting lower." Wim Roelandts, CEO of Xilinx, confirms the boost: "At 150 nanometers, we got order rates of 100,000 per year. With 90-nanometer technology, we're getting 1 million units per year regularly. At 65 nanometers, it'll be three million per year. With every generation, we become more competitive." (For more about Roelandts, see the Industry Insights Q&A, page 74.)

Some analysts are even more optimistic about growth in the PLD space, with even some of the smaller companies on the revenue list growing. "There are still opportunities in this space for new companies," says Jerry Worchel, semiconductor analyst for In-Stat (a division of Reed Electronics' parent company), citing QuickLogic's success with its QuickRAM and QuickMPU capabilities and Actel's success with military applications.

But the real opportunities for PLDs, analysts insist, are in consumer devices. "It's an open runway," says Worchel, "because we're putting more complexity into consumer electronics, but we've got all these standards to deal with." The best example is in cell phones, but the same capabilities affect all manner of consumer electronics. "If you can put a low-end FPGA into a phone and reconfigure it on the fly to go from the U.S. to Europe to Japan without forcing someone to buy a new phone, that makes it nice from the standpoint of inventory."

Worchel even postulates that manufacturers that know they're going to sell millions of devices, including game consoles such as the Xbox, will do initial development with FPGAs. Why? "Because they can get all the bugs out of the devices when it's cheaper." ■

Top Ten Programmable Logic Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	Xilinx	1,645	1,586	3.7
2	2	Altera	1,084	1,007	7.6
3	3	Lattice Semiconductor	210	226	-7.1
4	4	Actel	179	166	7.8
5	6	QuickLogic	48	45	6.7
6	7	Rohm	35	35	0.0
7	8	Atmel	30	24	25.0
8	5	Cypress Semiconductor	25	50	-50.0
9	9	National Semiconductor	11	13	-15.4
10	10	Anachip	3	4	25.0
		Total:	**3,270**	**3,156**	**3.6%**

Source: iSuppli

Howard Baldwin is former executive editor of Electronic Business.

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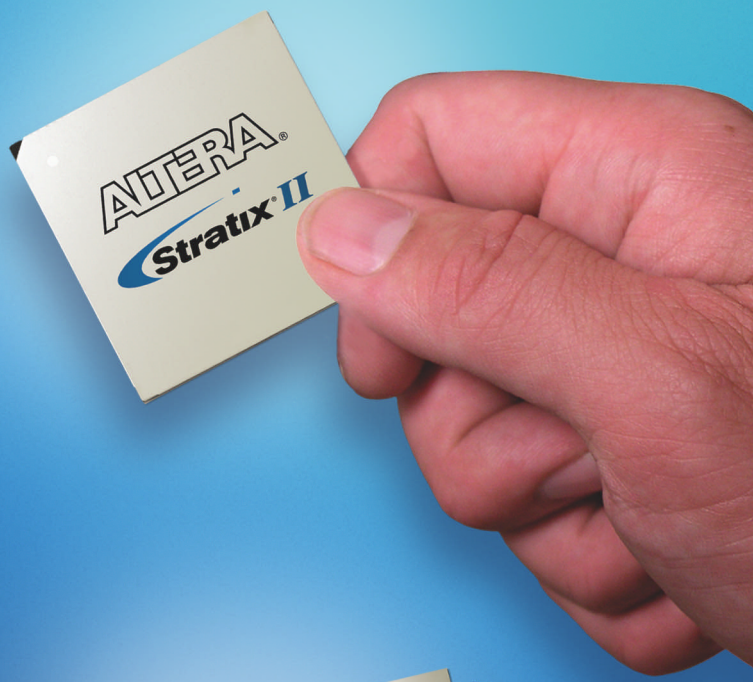

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Analog Technology's COMEBACK KID

By Maury Wright

Gary Grandbois, iSuppli

Analog is the new black on technology runways. The stability and economics of analog led National Semiconductor to refocus on the segment. Even market leader Texas Instruments rededicated itself to the segment when analog veteran Tom Engibous became CEO. But analog is no simple segment. The market is fragmented in terms of vendors and technologies. The IC vendor value proposition ranges from purely component price to application-specific specialty features.

For system designers, the resurgence of analog is understandable. Skyrocketing data rates have led a return to analog signal processing. Andy Rappaport, a venture capitalist at August Capital, made that point in the keynote speech at EDN's Innovation Awards banquet on April 3, noting that DSPs can't keep pace with today's speedy interfaces. National Semiconductor chairman and CEO Brian Halla always asserts analog ICs are critical to the user experience in hot products, driving HDTV displays or extending portable products' battery life, for instance.

The analog IC companies chased a total 2005 market value of $38.85 billion, states iSuppli; Garner Dataquest pegged it at only $32.0 billion. The difference highlights the fragmentation in analog and the difficulty of defining the term. iSuppli counts MEMS ICs in its analog forecast, including TI's DLP chips for TVs and projectors. Gartner doesn't count MEMS. But the definition question goes beyond MEMS.

Jean-Philippe Dauvin, chief economist and group VP at STMicroelectronics, states, "We use die surface area to define analog. If more than 50 percent of a chip's surface area is devoted to analog, it is analog. Less than 50 percent surface area means a digital chip. iSuppli and Gartner may define analog on a functional basis instead." These differing definitions affect the analysts' ranking of the competitors. As the chart indicates, iSuppli ranks STMicroelectronics second in analog. Says Steve Ohr, research director at Gartner Dataquest, STMicroelectronics ranks eighth in analog with $328 million in sales.

Within the analog segment, you can slice and dice the market several ways. Gary Grandbois, principal analyst at iSuppli, claims that about one-third of the market consists of standard linear ICs typically offered by multiple sources. The other two thirds, says Grandbois, are application-specific analog chips. Market leader TI divides the market even further. The company offers multisourced products through its Standard Linear & Logic Group. According to Ohr, that commodity business earns TI about $300 million.

The bulk of TI's analog revenue comes from the High Performance Analog group, which TI splits into application-specific and standard analog. The latter segment, managed by vice president of High Performance Linear Business Art George, includes four types of ICs: amplifiers, converters, interfaces and power management.

TI believes that even standard products in the high-performance segment deliver features to design teams that make or break a product. "When you think about high-performance analog products, it's really products that provide system-enabling performance," says George.

TI's analog-centric work is only part of the reason the company leads the analog segment. Its work in DSP—especially its mobile handset success—and its investment in semiconductor process technology are keys. George states, "Out strength in DSP and analog is what separates us from almost every other company in the industry. We are a great signal conditioning and processing company, be it analog or digital."

George may be correct, but it also doesn't hurt that TI can leverage its handset customers in a system sell, bringing high-performance analog and standard linear to the component buy. Regarding the system sell's importance for TI, Ohr proclaims it a "major advantage."

TI's fab capability helps it deliver high-performance products and hit cost targets. George states, "I want to reemphasize our synergy between the digital and analog businesses." ■

Maury Wright is editor-in-chief of EDN.

Top Ten Analog IC Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change	Percent of Total
1	1	Texas Instruments	4,450	4,423	0.6%	11.5%
2	2	STMicroelectronics	3,561	3,739	-4.8%	9.2%
3	3	Philips Semiconductors	2,449	2,179	12.4%	6.3%
4	4	Analog Devices	1,871	1,890	-1.0%	4.8%
5	6	National Semiconductor	1,738	1,730	0.5%	4.5%
6	5	Infineon Technologies	1,697	1,773	-4.3%	4.4%
7	7	Maxim Integrated Products	1,501	1,420	5.7%	3.9%
8	8	Freescale Semiconductor	1,233	1,195	3.2%	3.2%
9	11	Linear Technology	1,027	950	8.1%	2.6%
10	9	Matsushita Electric	1,017	1,145	-11.2%	2.6%
		Other Companies	18,309	17,832	2.7%	47.1%
		Total:	**38,853**	**38,276**	**1.5%**	**100%**

Source: iSuppli

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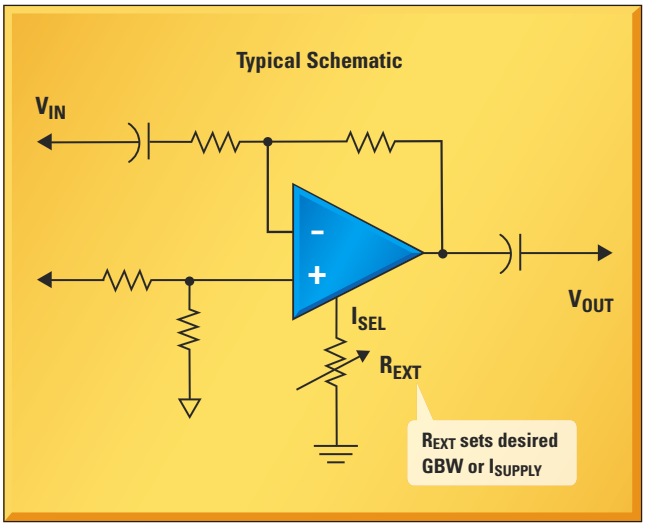

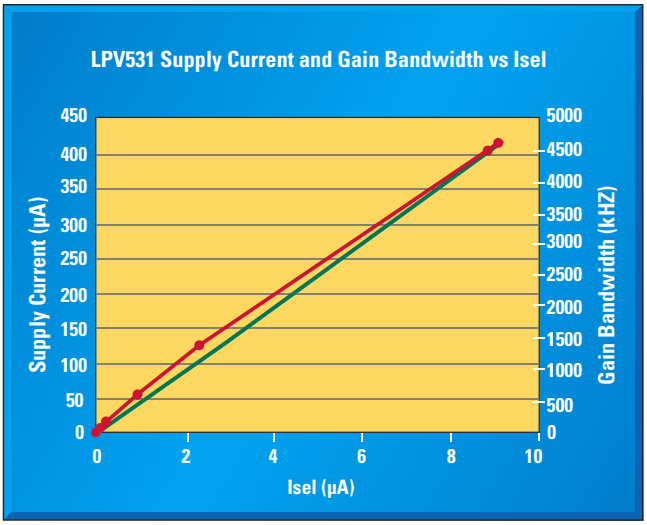

Product ID	No. of Channel	Typical Supply Current per Channel (mA)	Supply Voltage Range (V)	Input Offset Voltage (mV)	RRI/O	Unity Gain Bandwidth (MHz)	Low Input Current CMOS Design	Feature	Temp Range
LMP7711/12	S/D	1.15	1.8 to 5.5	0.15	RRO	17	✓	Shutdown	Ext
LMP7715/16	S/D	1.15	1.8 to 5.5	0.15	RRO	17	✓	—	Ext
LMP7701/04	S/Q	0.72	2.7 to 12	0.2	RRI/O	2.5	✓	—	Ext
LMV791/792	S/D	0.95	1.8 to 5.5	1.3	RRO	14	✓	Shutdown	Ext
LMV796/797	S/D	0.95	1.8 to 5.5	1.3	RRO	14	✓	—	Ext
LMV651/654	S/Q	0.11	2.7 to 5.5	1.5	RRO	12	—	—	Ext
LPV531	S	Program	2.7 to 5.5	3.5	RRI/O	Program	—	Stand-by	Ind
LPV511	S	880 nA	2.7 to 12	3	RRI/O	0.027	—	—	Ind

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The Sight & Sound of Information

In Flat Market, a Handful OUTPACE THE REST

By Russ Arensman

Keith Horn, Fujitsu

The old Charles Dickens phrase about it being the best of times and yet the worst of times rings true for today's application-specific integrated circuit (ASIC) industry. Whereas the overall market is essentially flat, a handful of companies is significantly outpacing the rest.

At the successful end of the market is IBM, whose ASIC sales grew 12.4 percent during 2005, to more than $2.3 billion, according to iSuppli. That's impressive, considering that worldwide ASIC revenues declined 1.8 percent during 2005, from $21.1 billion to $20.7 billion, and iSuppli expects them to grow less than 4 percent annually through 2010.

Thanks to its leading-edge technology, IBM has long supplied its ASIC design services to networking customers, such as Cisco Systems and Juniper Networks, that need to push the limits of chip performance. Yet the company's recent growth has come from consumer electronics. Besides powering the latest Xbox and PlayStation game consoles, IBM's ASICs are now finding their way into TVs, DVD recorders, camcorders and digital still cameras from the likes of Matsushita, Sharp and Sony.

Research firm Gartner reports that IBM's consumer ASIC sales more than doubled during 2005, from $210 million to $546 million, boosting it from No. 9 in consumer ASICs to No. 3.

Tom Reeves, IBM's vice president of semiconductor products, says consumer chip designs tend to be smaller, less complex and less costly than IBM's typical high-end ASICs. But IBM's reputation for designing custom chips that work on the first try is attracting consumer manufacturers struggling to keep up with fast-moving markets. Says Reeves, "We're finding that the predictability of our silicon is leading to our success."

At the market's other end are Japanese ASIC vendors NEC Electronics, Oki and Renesas, whose ASIC sales each fell more than 20 percent during 2005, according to iSuppli. Out of 2005's top 10 ASIC vendors, in fact, only four—IBM, Sony, STMicroelectronics and Texas Instruments—increased their sales last year.

Several factors are squeezing ASIC makers. Escalating design costs, which can exceed $30 million for a complex chip, deter some potential customers, although structured ASICs (which let customers tailor just the top metal layers of a standardized chip design) offer lower costs and shorter development time. The increasing performance of FPGAs also continues to erode ASIC sales, as customers that can afford higher prices opt for the shorter time to market of programmable chips.

The cost of new technology and manufacturing capacity is another big challenge. Although many ASICs are still designed with older, less expensive processes, the most lucrative high-volume custom chips now require 90-nanometer or smaller circuits to achieve the lowest-possible cost, better performance and power savings.

No. 5-ranked ASIC maker Fujitsu spent nearly $1 billion during 2005 on process technology and new fab development. Keith Horn, senior vice president of marketing for Fujitsu Microelectronics America, says the company will break ground this year on yet another $1 billion fab that will make 65-nm chips on 300-millimeter wafers. "For us, it's fundamentally important," says Horn. "Process technology underpins almost everything we do."

The costs are so daunting that even industry pioneer LSI Logic—ranked No. 11 by iSuppli despite nearly 21 percent ASIC sales growth during 2005—opted, in April 2006, to sell its last remaining manufacturing plant and shift to a fabless strategy. The company also recently decided to stop developing its structured-ASIC product line and focus its remaining ASIC business on storage and consumer products.

That's clearly the approach of No. 8-ranked Agere Systems, which is offering its ASIC designs only to customers in storage, enterprise and communications. The handwriting is on the wall, says Tim Moeller, an Agere ASIC marketing manager: "It's too expensive these days to be everything to everybody." ■

Top Ten ASIC Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	Texas Instruments	2,820	2,568	9.8%
2	2	STMicroelectronics	2,452	2,410	1.7%
3	3	IBM Microelectronics	2,365	2,105	12.4%
4	4	Freescale Semiconductor	1,531	1,540	-0.6%
6	5	Fujitsu	1,314	1,366	-3.8%
5	6	NEC Electronics	1,119	1,530	-26.9%
7	7	Renesas Technology	920	1,199	-23.3%
8	8	Agere Systems	917	1,019	-10.0%
9	9	Toshiba	872	875	-0.3%
10	10	Sony	866	739	17.2%
		Others	5,542	5,753	-3.7
		Total:	**20,718**	**21,104**	**-1.8%**

Source: iSuppli

Technology writer Russ Arensman writes frequently for Electronic Business.

DRAM Market as Dangerous, er, DYNAMIC AS EVER

By Tracy Mayor

Steve Appleton, Micron Technology

Razor-thin margins. Precipitously falling prices. Near-chronic oversupply. To many industry watchers, that, in a nutshell, is the perpetual state of the marketplace for DRAM, the essential, if unexciting, memory chips used in the vast majority of desktop and notebook computers.

Well, not that unexciting. In late April, Rambus won a $306.5 million patent infringement case against Hynix which could roil the DRAM market in similar fashion to how NTP tamed the BlackBerry juggernaut. What's for sure is that Rambus will have more leverage now in its legal pursuit of DRAM makers such as Samsung and Micron.

To Micron Technology CEO Steve Appleton, those ups and downs are business as usual. As No. 3 in the market for memory, behind perennial powerhouse Samsung Electronics and Korean competitor Hynix Semiconductor, Micron has learned that the key to the DRAM marketplace is to diversify, Appleton says.

Like its counterparts at the top of the market, Micron has in the past year devoted considerable resources to the sexy, high-growth side of the memory market—that is, to NAND flash memory, which is used in MP3 players, digital cameras, USB drives and other hot consumer devices (see flash memory story, p.50). Last November, hoping to capitalize on that growing market, Micron entered into a partnership with Intel to produce NAND chips.

But that doesn't mean that Micron is ready to write off the DRAM side of the memory market, Appleton says, not by a long shot. The company is taking a high/low approach to success in DRAM—offering, on the one hand, higher end (and higher margin) "specialty DRAM" and, on the other hand, continuing to compete in the volume-driven market for commodity DRAM by making as many chips as possible as efficiently as possible.

"The market for specialty DRAM—DRAM that has been customized in some way—is growing rapidly," Appleton says. "Mobile DRAM, low-power DRAM: That part of the market is pretty exciting, and we see it as a high-growth, high-penetration area."

IDC projects that the DRAM market will be valued at $27 billion in 2006, rising to $41 billion by 2010, which isn't exactly explosive growth, admits PC chip analyst Shane Rau. And that data, he points out, comes on the heels of several years that were drastically difficult for memory chip manufacturers. "The years 2001 and 2002 were just terrible, terrible years," Rau recalls.

As unglamorous and volatile as it is, the market for commodity DRAM in 2006 is still where the lion's share of the money is to be made, Rau says. The company that makes the most chips for the least amount of money is the winner, and right now nobody does that better than Samsung. "If you're going to make money in commodity DRAM, you need huge capacity. Samsung has invested heavily in lots and lots of capacity, which means that it can play in the mainstream market and have capacity left over to devote to NAND and specialty DRAM chips."

In the remaining months of 2006, the players are hoping to see an increase in DRAM demand as businesses and consumers buy new desktop and laptop machines in anticipation of Microsoft's long-awaited Windows Vista.

Microsoft recently pushed back the due date of the commercial version of Vista, now not due until January 2007, which caused a temporary drop in stock value for computer OEMs and DRAM manufacturers.

Where some DRAM makers and market watchers are waiting for a Vista-driven jump in demand, Micron's Appleton takes a more pragmatic view. "I don't think it will be the big step-up that some people may be anticipating," he observes. "All of the corporations know that Vista is coming; all of the OEMs want to have Vista-compliant machines ahead of time. I see it more as a gradual increase, a steady rise in demand." ■

Top Ten DRAM Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	Samsung Electronics	7,460	7,531	-0.9%
2	2	Hynix	4,117	4,288	-4.0%
3	3	Micron Technology	3,853	4,209	-8.5%
4	4	Infineon Technologies	3,226	3,681	-12.4%
5	5	Elpida Memory	1,776	1,807	-1.7%
6	7	Nanya Technology	1,509	1,179	28.0%
7	6	Powerchip Semiconductor (PSC)	1,241	1,329	-6.6%
8	8	ProMOS	860	1,165	-26.2%
9	11	Etron Technology	161	180	-10.6%
10	14	Integrated Silicon Solution (ISSI)	153	113	35.4%
		Other Companies	459	964	-52.4%
		Total:	**24,815**	**26,446**	**-6.2%**

Source: iSuppli

Tracy Mayor is a freelance writer who contributes often to Electronic Business.

Continual Innovation Pushes POWER MANAGEMENT

By Warren Webb

Fulvio Abela, STMicroelectronics

By the time you get out of bed, dash to work and log into your desktop computer in the morning, dozens of specialized management semiconductors have already been working hard to optimize your power usage. These power management devices are found in almost every electronic product ranging from MP3 players to military avionics. Designers rely on them to minimize energy consumption, dissipate heat, reduce the hardware form factor and decrease system cost. With roots in simple rectifiers and regulators, power management devices are the building blocks necessary to translate, regulate and control the power needs of modern electronic devices and systems. In portable electronic devices, power management circuits are responsible for extending battery life and minimizing charging times.

No one supplier dominates the power management sector, with STMicroelectronics hovering around 10 percent market share. According to iSuppli, the power management semiconductors group came in with a 2005 fourth-quarter growth of about 5.4 percent, while the semiconductor industry overall experienced a -1.7 percent growth from the third quarter to the fourth quarter.

"Power management is the basis of all electronic systems. No matter what, you must have some power management on your board," notes Fulvio Abela, STMicroelectronics' director of marketing for power and analog products. "So far, it has been difficult to integrate the power functions inside a bigger chip due to the cost of integration and because most power management chips require a different mask set. Our strategy is to provide system solutions to our customers so we deliver everything from the controller or driver or regulator to the discretes."

With the relentless procession of new technologies, power management vendors need to innovate to succeed. This year's segment leader also won *EDN* magazine's innovation of the year award for power ICs. STMicroelectronics topped other contenders with its STw4141 dc/dc converter, designed for use with digital baseband and multimedia processors in portable applications. The novel circuit allows two different output voltages to be generated with a single external coil, reducing parts count and manufacturing cost. "The STw4141 will make a significant contribution toward a reduced bill of materials for cell phone manufacturers, enabling them to bring out world-beating mobile products that are smaller, cheaper, and provide even longer battery life, says Eric Aussedat, general manager of STMicroelectronics' cellular communications division."

One of the hottest application areas for power management devices over the next few years will be automotive electronics. The proliferation of electronics in entertainment systems, power-train controls and safety components is fueling the steady growth of automotive power management devices. Overall, automotive exceeds the rate of growth in all other major electronic equipment segments, including data processing and mobile communications. iSuppli predicts revenues from shipments of power management ICs for automotive uses will grow to $5.3 billion by 2008.

Digitally controlled power, a new trend in power management, has the potential to shake up the segment. These ICs integrate microcontrollers, application-specific silicon and software algorithms for monitoring, data exchange and control of power systems. ■

Top 10 Power Management Companies

2005 Rank	2004 Rank	Company Name	2005 Revenue (Millions of Dollars U.S.)	2004 Revenue (Millions of Dollars U.S.)	Percent Change
1	1	STMicroelectronics	2019	2014	0.2%
2	2	Texas Instruments	1594	1462	9.0%
3	3	Fairchild Semiconductor	1074	1216	-11.7%
4	4	International Rectifier	1074	1145	-6.2%
5	6	Infineon Technologies	1048	1032	1.6%
6	7	National Semiconductor	959	926	3.6%
7	5	Renesas Technology	936	1058	-11.5%
8	8	Philips Semiconductors	900	860	4.7%
9	9	Toshiba	822	781	5.2%
10	11	On Semiconductor	703	728	-3.4%
		Rest of Market:	10900	10651	
		Total:	**22029**	**21873**	**0.7%**

Source: iSuppli

Warren Webb is a technical editor for EDN.

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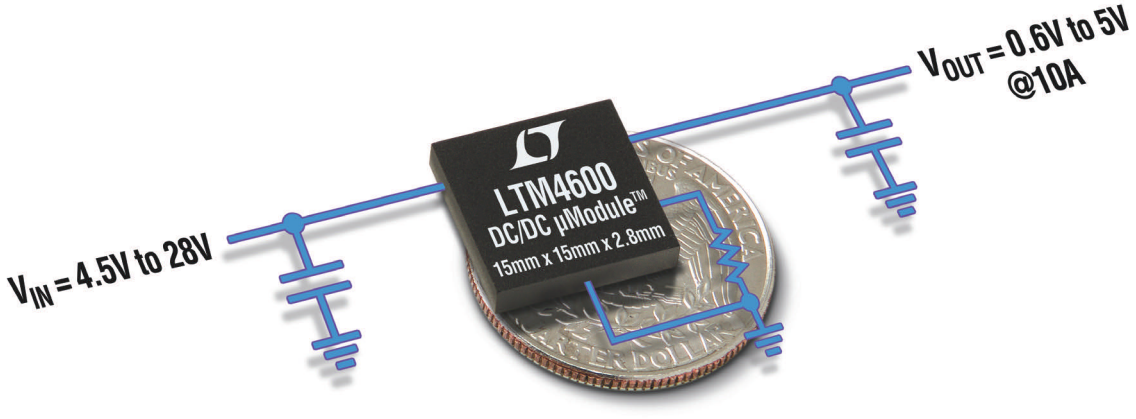

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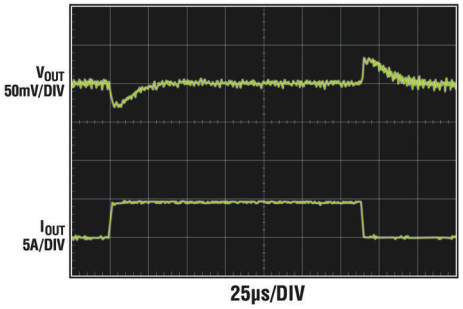

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LINEAR TECHNOLOGY

Memory Market's Bright Spot: NAND FLASH

By Tam Harbert and John Dodge

Mark DeVoss, iSuppli

Last year was good for NAND flash memory, and many more good years lie ahead.

On a revenue basis, NAND grew by 57 percent, from $6.5 billion in 2004 to an estimated $10.2 billion. Also, NAND revenues passed those of NOR memory for the first time, according to figures from IC Insights. Conversely, NOR had a rough year in 2005, due to greater competition among NOR suppliers, and a maturing of its primary market—mobile phones—led to a drop in revenues of more than 13 percent.

The attraction of NAND—low cost per bit, high densities and short write times—has driven its adoption in several portable data storage applications. The No. 1 application is removable memory cards such as those used in digital cameras, followed by USB thumb drives and MP3 players, according to Mark DeVoss, senior analyst at iSuppli.

And now NAND suppliers are eyeing new frontiers for their chips, which include moving in on NOR's territory. Cell phones have used NOR flash to store the BIOS code needed to boot up the device and to store small amounts of data, such as names and phone numbers. Although NOR doesn't have the high density or fast write speeds of NAND, it was perfect for code, because it was less error-prone than NAND and had the fast read speed required to execute the code.

But as phones add high-end features such as cameras and Web browsing, they need more storage for all those pictures and data—a perfect opportunity for NAND, which routinely comes in 8-gigabit densities and is expected to reach a density of 16 gigabits this year. Not only do NAND suppliers want to provide that storage but they also want to displace NOR in high-end cell phones.

Samsung Semiconductor, the leader in NAND, with more than half of the market, took a step in that direction last year, when it introduced OneNAND, a hybrid chip combining a NAND flash chip with a NOR interface. According to Dan Barnetson, Samsung's associate director of flash marketing, the part offers the best of both worlds: the fast read speed of NOR along with the fast write speed and low cost of NAND.

Even Intel, which invented NOR and is a major supplier of NOR memory, has come to the NAND table. In November of last year, it joined with Micron Technology to create a $5 billion manufacturing partnership at three U.S sites to start cranking out NAND flash. Intel executives said the company would get a ready supply of NAND right away by partnering with Micron instead of starting from scratch and falling further behind in this lucrative market. And whereas Micron moved from No. 13 to No. 8 last year in overall flash memory sales, it's headed into fourth position this year in NAND.

But Intel and the rest of the NOR folks are not giving up. In September, NOR vendor Spansion introduced its own hybrid, called Ornand, which combines NOR with a NAND interface. At 1 gigabit, it doesn't match the density of NAND, but it still holds more data than previous NOR chips, and it has faster write speeds. And in November, Intel introduced a 1GB NOR part that has twice the read speed and more than three times the write speed of its previous NOR parts.

Analysts question whether NAND can push NOR out of cell phones anytime soon. Although handsets need NAND for data storage, they'll keep NOR for code execution, says DeVoss. Why? Cost. NAND is less expensive on a per-bit basis than NOR, but NAND manufacturing resembles the DRAM business, requiring higher densities to maintain profitability, according to DeVoss. ■

Top Ten Flash Memory Companies

(Millions of Dollars U.S.)

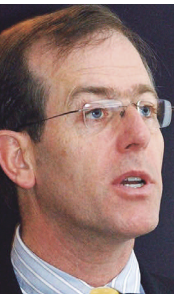
2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change	Percent of Total
1	1	Samsung Semiconductor	6,171	4,364	41.4%	33.1%
2	3	Toshiba	2,722	2,349	15.9%	14.6%
3	4	Intel	2,278	2,285	-0.3%	12.2%
4	NA	Spansion	2,054	0	N/A	11.0%
5	10	Hynix	1,382	221	525.3%	7.4%
6	5	STMicroelectronics	1,320	1,194	10.6%	7.1%
7	6	Renesas Technology	831	865	-3.9%	4.5%
8	13	Micron Technology	360	175	105.7%	1.9%
9	7	Sharp Electronics	357	648	-44.9%	1.9%
10	8	Silicon Storage Technology	329	428	-23.1%	1.8%
		Other Companies	817	3,385	-75.9%	4.4%
		Total:	**18,621**	**15,914**	**17.0%**	**100%**

Source: iSuppli

Tam Harbert is a contributing editor for Electronic Business. *John Dodge is editor-in-chief of* Electronic Business.

IP Still Hip Though NOT ALWAYS PROFITABLE

By Mike Green



Chris Rowen, Tensilica

Rich Warmke, Rambus

OEMs are looking to differentiate themselves from their competition, while getting products out quicker. Making use of expertise outside their own organizations has set the stage for the IP business to really take off, as vendors can share development costs across many customers. The space seems set for growth; Semico predicts the worldwide IP market will reach $4 billion by 2008. Yet, there are pitfalls to be avoided, and to date only a handful of companies here have actually proved profitable. So, is IP a golden opportunity or poisoned chalice?

MIPS Technologies entered this space back in 1997, gaining lucrative contracts from key game machine manufacturers. Jack Browne, its marketing director, explains "Moore's Law demands increasing numbers of transistors, but [EDA] companies lack the productivity or design verification to create these chips in the time available. The only way to meet these requirements is by reusing specialized IP." Its rival ARM is perhaps the shining example of what can be achieved. It supplies RISC-based processor architectures to 85 percent of all cell phones and incorporates its technology into the Apple iPod.

Tensilica has been gaining momentum on the fringes of the processor industry for some years, and is now coming of age. CEO Chris Rowen feels "integration levels have become so high that the tactics previously employed by semiconductor firms no longer apply. IP suppliers have a crucial role in forming more complex, power-efficient IC solutions." To add to its line of highly-respected configurable cores, Tensilica recently introduced a set of standard cores, taking on ARM in its own back yard. Rowen argues that "a broad portfolio allows us to reach a stage of critical mass that ensures self-sustainability. Vendors without breadth will have a shelf-life problem. Nobody wants to be a flash in the pan, providing IP that's attractive today, but completely redundant next year."

But how does a would-be client make sure it picks the right vendor? Thanks to the low initial investment needed to break into this market, it has become an attractive route for entrepreneurial engineers to establish their own startups. The downside is it has simply become too easy, and the sector has been flooded with people looking to mirror ARM's success.

Browne explains, "There are many suppliers producing similar products. Only those capable of delivering something with true value, that would take their customers longer or cost more to do in-house, will be successful." Though Rowen agrees that in the past the presence of me-too players created confusion for customers, nowadays they are far more aware.

Though straightforward to get into, there's no easy way out of the field. Firms using IP as a stepping stone by which to evolve into a fabless chip producer have found insurmountable barriers blocking their way. It is very hard to expand beyond these confines, since this could be judged by the customer base as a threat.

Also, defense of the expertise at the foundation of these companies' products is of prime importance. Emerging nations like China and India, which often have scant regard for copyright laws, are a worry for all involved. However, some vendors are judged to use their patents not to protect themselves, but as a means of attack. Interface IP producer Rambus has caused quite a stir in the non-volatile memory market with a series of high-profile litigations against such names as Hynix and Micron.

Rich Warmke, of Rambus' Platform Solutions division states, "Our business model is somewhat different than other firms'. We focus on creating solutions that will be vital to the market five years out, then look for suitable remuneration." Accusations abound that the company has effectively created toll booths on particular technology paths, and thus holds firms to ransom. Rowen believes anyone concentrating on legal concerns rather than technical ones will struggle in the long term. In his opinion, "spending more time in the courtroom than the development lab means something is wrong with your strategy, and your relationships with clients are going to be constantly strained." ■

Top Ten IP Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	ARM	373.1	312.2	20%
2	2	Rambus	157.2	144.9	9%
3	4	Synopsys	81.2	76.2	7%
4		Saifun	78.6	30.6	157%
5	5	MIPS Technologies	58.7	56.9	3%
6	6	Virage Logic	51.3	53.0	-3%
7		Mosaid Technologies	40.4	13.5	199%
8	7	Ceva	35.6	37.7	-6%
9	8	Imagination Technologies	29.2	28.6	2%
10	9	Mentor Graphics	28.8	26.9	7%
		Top Ten	934.1	780.5	20%
		Others	484.6	443.8	9%
Total:			**1,418.7**	**1,224.3**	**15.9%**

Source: Gartner Dataquest (May 2006)

Mike Green is the managing editor for EPN*, based in Wales.*

MCUs Grow in Specific Applications, DECLINE OVERALL

By Jessica Davis

Steve Sanghi, Microchip Technology

The microcontroller market is rarely, if ever, considered to be on the leading edge of technology. Rather, this market is made up of many different players serving many different end applications.

The market is defined by its extreme diversity—from the most complex 32-bit MCUs found in automobiles to the simplest parts, all the way to 4-bit, that control the motors in washing machines, among other applications. In some cases, these smaller parts have taken some business away from discrete semiconductors.

And unlike memory, which can be a wildly fluctuating market, the MCU space is more stable. In 2005 overall revenues declined slightly from 2004, according to Jordan Selburn, principal analyst for core silicon at iSuppli. General-purpose MCUs declined at a faster rate than the segment did as a whole, with selected application areas tending to perform better, says Selburn.

"I think we are seeing a trend toward more application-specific MCUs," says Selburn. For example, general-purpose MCUs declined by close to 4 percent, whereas those for the application-specific automotive segment increased by 3.7 percent.

"In some specific application areas where we are seeing higher semiconductor content, that is driving some growth in the area," he says. And Renesas, the No. 1 company, is certainly a large supplier in the automotive arena.

No. 4 on the list, Infineon, is another good example of a company that experienced that shift. Its multipurpose microcontroller business overall declined by 13 percent, according to iSuppli, but its automotive business for MCUs grew by 6.2 percent. Most of Infineon's MCU decline was attributable to its smart card business, which took a 23.3 percent hit in 2005.

In spite of the pain from smart cards, Infineon fared well overall. The company attributes at least part of that success to having a large and diverse portfolio of parts for customers to choose from—probably more than 150 different parts total, according to Stephan Zizala, the company's senior manager for product marketing and application engineering.

Microchip was one of the few companies that moved on the list year-over-year. This year the pure-play MCU maker moved into the No. 5 slot from No. 6, where it was last year. The company, a big player in general-purpose MCUs, bucked the trend and showed growth for those parts.

The rankings saw more shuffling at the bottom of the list, with Toshiba and Matsushita each moving down by one slot after Microchip's rise. Fujitsu remained firm at No. 8, and Samsung debuted at No. 9, up from No. 12 last year. Atmel rounded out the top 10, in last place, falling one position from last year.

Overall, the 4-bit market declined by 10.5 percent and the 8-bit market was down 3.4 percent, according to iSuppli. The 16-bit market was down 4.1 percent. The 32-bit market was the only space that showed growth, up 3.3 percent, says iSuppli.

In the 32-bit market, the leader overall is Freescale Semiconductor, according to Selburn, with 17.7 percent of the market. Renesas, the leader in the overall MCU market and the previous leader in the 32-bit space, is now No. 2, with 13.8 percent of the market. NEC is a relatively close third, with 11.6 percent of the market. Fujitsu and Infineon are running neck-and-neck behind that, with just over 9 percent of the market each. The 32-bit market makes up about 25 percent of the overall MCU market, according to iSuppli.

Will the market next be headed to 64-bit? Selburn believes that that is unlikely, as 32-bit is still providing all the compute power needed from MCUs at the moment. ■

Top Ten Microcontroller Companies

2005 Rank	2004 Rank	Company Name	2005 Revenue (Millions of Dollars U.S.)	2004 Revenue (Millions of Dollars U.S.)	Percent Change	Percent of Total
1	1	Renesas Technology	2,831	3,036	-6.8%	20.5%
2	2	Freescale Semiconductor	1,731	1,717	0.8%	12.6%
3	3	NEC Electronics	1,332	1,410	-5.5%	9.7%
4	4	Infineon Technologies	925	1,065	-13.1%	6.7%
5	6	Microchip Technology	718	665	8.0%	5.2%
6	7	Toshiba	716	647	10.7%	5.2%
7	5	Matsushita Electric	637	747	-14.7%	4.6%
8	8	Fujitsu	635	620	2.4%	4.6%
9	12	Samsung Electronics	533	446	19.5%	3.9%
10	9	Atmel	526	514	2.3%	3.8%
		Other Companies	3,208	3,258	-1.5%	23.3%
		Total:	**13,792**	**14,125**	**-2.4%**	**100%**

Source: iSuppli

Jessica Davis is a senior editor at Electronic News.

ODMs Pin Hopes on SPECIALIZED SERVICES

By Robert L. Scheier

John Collins, Wistron

Just as their electronic manufacturing services (EMS) counterparts are moving into product design to protect their profit margins, original design manufacturers (ODMs) are moving beyond product design into new product areas and offering specialized services in order to differentiate themselves from the pack.

Asian ODMs sold about $38 billion in products in 2005, a market that is expected to reach $78 billion by 2009, says Prakash Vaswani, an analyst at market research firm In-Stat. During that time, he expects ODM sales will make up 48.4 percent of all electronics manufacturing in the region, he says, up from 45 percent in 2005. The hub of worldwide ODM activity is still in Taiwan, analysts say, because of its experience, close ties with OEMs and its wide variety of component vendors. But as with virtually all other forms of manufacturing, ODMs are increasingly moving actual product production to China.

Between 2004 and 2005, the revenue rankings of the top ODMs showed little change, with Tatung falling from eighth to ninth on a 27 percent drop in revenue, and Mitac International moving up one place to 10th on a 50 percent rise in sales. Several other firms enjoyed 30 to 40 percent increases in sales, including Taiwan-based Wistron.

Since being spun out of parent company Acer in May 2001, Wistron has grown into a $3.5 billion ODM player with more than 20,000 employees. While some OEM customers purchase Wistron-designed products such as notebook computers off the shelf, "to differentiate ourselves, we put much focus on identifying the services hoped for by our customers," says John Collins, Wistron's director of corporate communications.

"This might be a broader range of environmental testing services to real-time reporting from manufacturing shop-floor control systems," Collins says. For example, "we now use IT links to port manufacturing data to customer sites. The data covers all aspects, including quality-control reports."

Like the EMS players, ODMs need to—and are succeeding at—forming closer relationships with their OEM customers, says Collins. "As ODMs gain in experience and expertise, the reluctance to outsource more products, and higher end products, decreases," he says. "The last few years has seen much in-depth cooperation between ODMs and their customers, leading to easier cooperation in the future." Collins also sees Japanese OEMs turning to ODM vendors more frequently than in the past.

Productwise, Collins expects to see "notebooks continue to keep their growth pattern, with higher end products now outsourced." Looking forward, server and storage products "could become the highest growth area, in percentage terms," he says. While Collins recognizes the trend of EMS vendors shifting toward an ODM model, he says that "it might not be worth the added resources needed to try to compete directly with Taiwan ODMs in a very established market," such as those for notebook and desktop computers. And as Taiwan-based ODMs "grow in size, they may become less and less an option for EMS acquisition," he says.

Just as for the EMS vendors, says Collins, "ODMs should understand very clearly their customers' road maps, including those higher end products. There is room to grow on customers' road maps for those companies that can keep pace with technology and execute at the level of efficiency to satisfy customers. Whether it is blade servers, or high-end notebooks, the ODMs can carve out their market share through execution."

But in today's market, execution means more than just low price and high quality. It means offering services your competitor cannot. ■

Top Ten ODM Companies

2005 Rank	2004 Rank	Company Name	2005 Revenue (Millions of Dollars U.S.)	2004 Revenue (Millions of Dollars U.S.)	Percent Change
1	1	Quanta Computer	$12,523	$9,665	30%
2	2	Asustek	$10,737	$7,826	37%
3	3	Compal Electronics	$6,860	$6,433	7%
4	5	Lite On Technology	$5,054	$4,959	2%
5	6	Inventec	$5,048	$4,236	19%
6	4	BenQ	$5,043	$5,016	1%
7	7	Wistron	$4,814	$3,545	36%
8	9	Inventec Appliance	$3,577	$2,454	46%
9	8	Tatung	$2,338	$3,216	-27%
10	11	Mitac International	$2,307	$1,543	50%
		Total:	**$58,300**	**$48,449**	**20%**

Source: iSuppli

Robert L. Scheier is a contributor to Electronic Business.

Surge in Corporate Capex SWEETENS OUTLOOK

By Barbara Jorgensen

Roy Vallee, Avnet

You know there's been a prolonged rough patch for the channel when distributors question whether the growth they're experiencing is "real" or just another seasonal blip. But by the end of the first quarter, channel executives were pretty comfortable with the idea that 2006 will join 2005 as a year of growth for the industry.

The fundamentals underlying this growth, executives and analysts say, is the reason for continued optimism. After four years of conservative spending, corporations are finally opening the coffers for capital expenditures. "In calendar 2005, we began to experience the resumption of spending by businesses, says Roy Vallee, CEO of No. 1 distributor Avnet.

Prior to this, the electronics industry was fueled by growth in consumer electronics—not a big market for the channel. "Corporate capex is the sweet spot for industrial distribution," says Brian Alexander, an analyst with Raymond James Associates.

Rather than experiencing a huge spike, though, Vallee says, capex is returning to a more normalized level after the peaks and valleys of the past five years. "If you look at capital expenditures as a percentage of GDP [gross domestic product], you'll see that prior to the bubble, capex spending on IT peaked at something like eight times the GDP—two times the GDP is considered normal spending," he says. Then came the collapse, and capex dropped below the trend line. "So in 2001 and 2002, the industry had negative growth; 2003 was flat and 2004 slightly up; and in 2005, we approached capex spending at two times the GDP," he says.

The shift from consumer to IT spending means that distribution should see growth slightly above the industry average for the rest of the year. When consumer electronics were driving the market, says Alexander, semiconductor industry growth (which is used as a baseline for distribution) outpaced distribution by 3 percent to 5 percent through the third quarter of 2005. "For the December 2005 quarter and the March 2006 quarter, the semiconductor industry grew about 8.5 percent year-over-year," he says. "The distribution industry in aggregate grew at about 9.5 percent." Barring any major correction, he says, distribution could enjoy that growth rate through the rest of the year.

There are, of course, challenges. Europe's Restriction on Hazardous Substances (RoHS) regulations take effect in July, and this may have an impact on distribution inventory. The distribution channel continues to serve customers that must comply with RoHS, which bans certain substances-including lead-from electronics products, and those that don't. Therefore, distributors will have to carry inventory of both leaded and unleaded components. A spike in demand for either category of devices could cause a supply overage or shortfall.

The flip side, Alexander says, is the ability to extract value from customers that still need leaded parts. If lead is phased out entirely by the industry-and this seems like a reasonable outcome—leaded parts can be treated as end-of-life (EOL) parts: ones that will no longer be manufactured. EOL management is a big business for distribution and is highly profitable when demand for a discontinued product spikes.

It may not be too much longer before the channel sees which way the market is going. Any impact from RoHS, Alexander says, should start showing up this quarter. ■

Top Ten Distributors

NORTH AMERICA

(Millions of Dollars U.S.)
Calendar Year 2005-2004

Rank	Company Name	North American revenue	Total revenue 2005	Total revenue 2004	Percent Change
1	Avnet Inc.	6,582.9	12,611.0	10,766.0	17%
2	Arrow Electronics[3]	6,419.4	11,164.2	10,646.1	5%
3	Future Electronics[1]	2,769.8	3,956.8	3,381.7	N/A
4	Bell Microproducts Inc.	1,502.6	3,197.0	2,827.8	13%
5	TTI Inc.	576.2	835.0	775.0	8%
6	Digi-Key Corporation	566.9	629.9	530.5	19%
7	Newark InOne[2]	536.7	729.7	547.7	33%
8	Smith & Associates	509.0	509.0	513.0	-1%
9	Converge	454.0	454.0	390.0	16%
10	All American	426.3	435.0	410.0	6%

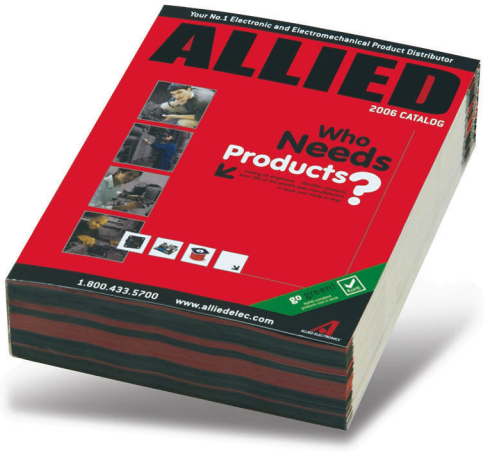
Source: Reed Research

1 Revenue figures and percentages by region are Reed Research estimates.

2 Newark InOne is the main North American presence of parent company Premier Farnell (West Yorkshire, England) in electronic component distribution. Premier Farnell's 2005 revenue was $1.46 billion.

3 Percentages by region are Reed Research estimates.

Barbara Jorgensen is a senior editor at Electronic Business.



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How Foxconn SURPASSED FLEXTRONICS

By Howard Baldwin

Jeffrey Wu, iSuppli

For six years, Flextronics has been at the top of the contract manufacturing heap, sometimes trading places with Solectron for the No. 2 spot, but mostly winning. Not in 2005, though: Low-profile Hon Hai, which goes by the name Foxconn in the United States, surpassed Flextronics in revenue. The totals, according to iSuppli: $21 billion for Hon Hai and $15.58 billion for Flextronics.

Compare that with figures from 2004, when Foxconn was only nipping at Flextronics' heels, and you get a spectacular leap of 33 percent for the former and a 3 percent drop for the latter. This must be why Flextronics CEO Michael McNamara refused to be interviewed for this story.

Granted, 2005 wasn't a great year overall for contract manufacturers. Of the top five, Foxconn was the only one to increase revenues. The others lost anywhere from 3 percent to 12 percent compared with 2004—and that was when business was improving. The bottom five did better, with some showing double-digit increases and two showing just 1 percent increases.

"The biggest challenge for these companies right now is that even if they get contract wins, they can't translate them into profitability," laments Jeffrey Wu, an analyst for iSuppli's electronics manufacturing services (EMS) and original design manufacturer (ODM) services. "Internally, they're not operating effectively enough yet, even though they're shifting capacity from high-cost countries to low-cost countries, introducing lean manufacturing and offering design capabilities."

But how did Foxconn do so well? This is the company that taught the CIA how to be secretive. When *Electronic Business* profiled its parent company in April 2004 (see "Why Is Hon Hai So Shy?" [http://www.reed-electronics.com/eb-mag/article/CA405740]), only a spokesperson responded, commenting sparingly. (The same spokesperson did not respond to interview requests for this story.).

Nor is the company cagey solely with journalists. "Several of our clients complain they don't have information about them, and it's frustrating," says Pamela Gordon, president of supply-chain consulting firm Technology Forecasters Inc. (TFI).

Gordon adds that TFI is currently wrapping up a survey related to customer satisfaction among OEMs using contract manufacturers. The initial results show that when asked about their suppliers' global supply-chain coordination and execution, Hon Hai customers that also use other contract manufacturers rated the company lower compared with the others they use. Hon Hai's rating: 3.3 on a scale of 5, where 5 equals "delighted customers" and 3 equals "meets expectations."

By comparison, notes Gordon, Elcoteq earned an average of 4.0 from these same OEMs, Flextronics 3.8, Jabil 3.7 and Solectron 3.5. "In no category did Foxconn perform best out of the [contract manufacturers] used by the OEMs who also rated Foxconn," she says, "not even when we asked, 'How would you rate your EMS/ODM suppliers' skill at reducing total cost of ownership?'"

This begs the question of why the company is nonetheless doing so well financially. "Its bid packages are very attractive," acknowledges Gordon.

In the hot wireless handset space, Wu says, Foxconn has simply been besting Flextronics, counting Motorola, Nokia and Sony Ericsson among its customers; Flextronics works with Kyocera. The tally, according to Wu: Foxconn shipped 36 million handsets compared with Flextronics' 8 million.

Is it simply that Foxconn is serving companies that don't need a lot of interaction and don't want traditional customer service? That's possible, but even Wal-Mart has store greeters to improve its image. As anyone who lived through the boom remembers, companies don't make decisions solely based on price. The issues of trust and collaboration enter into the decision-making process as well, and it's likely that in the future, either Foxconn will train its customers not to expect those elements or its customers will force the company to do business differently. ■

Howard Baldwin is former executive editor of Electronic Business.

Top Ten Electronics Manufacturing Services Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	2	Foxconn	20,981	15,811	33%
2	1	Flextronics	15,582	16,062	-3%
3	3	Sanmina-SCI	11,343	12,484	-9%
4	4	Solectron	10,207	11,630	-12%
5	5	Celestica	8,471	8,839	-4%
6	6	Jabil Circuit	8,057	6,575	23%
7	7	Elcoteq	5,179	3,899	33%
8	9	Venture	3,238	3,194	1%
9	8	Benchmark	2,257	2,001	13%
10	10	Universal Scientific Industrial	1,621	1,613	1%
		Total:	**86,936**	**80,859**	**8%**

Source: iSuppli

Steady Growth, But A MARKET TRANSFORMS

By Ann Steffora Mutschler

Dr. Aart de Geus, Synopsys

Similar to the tumultuous dynamics semiconductor suppliers have gone through in the past five years, the electronic design automation (EDA) market is going through a transformation. Meanwhile, it has maintained a modest but steady growth rate, reaching $4.6 billion in revenues for 2005.

A number of variables put pressure on semiconductor vendors over the past several years, including the 2001 industry downturn. During this time, semiconductor manufacturing moved to 300-millimeter-size wafers and struggled with yield management in its shift to 130-nanometer process technology, notes Dr. Aart de Geus, chairman, president and CEO of Synopsys. At the same time, there has been enormous growth in China and India over the past five years as they have become major market and employment segments.

"All of this has happened in the past five years, and EDA is sitting in the midst of it because we touch the system providers that design entire products, be it phones or iPods," de Geus explains. "We touch the integrated device manufacturers that do the chip design and the manufacturing. We touch the fabless segment that does the same thing but without the manufacturing by virtue of the foundries. Last but not least, we touch a bit of the equipment industry by virtue of the connection with [design for manufacturing]."

EDA is indeed changing. For years, industry players like Synopsys, Cadence Design Systems and Mentor Graphics have focused on developing point tools aimed at the next round of Moore's Law. Now they must not only stay on the leading edge of technology, but also deal with productivity and predictability.

From a design point of view, this means very complex chips are being designed for high-volume products, with cost-per-part and yield being important issues. Getting to market in a predictable fashion—another pressing matter—requires functional correctness and reasonably predictable design flows, de Geus continues.

"Increasingly, all of this is only achievable if design flows are implemented that have been designed for productivity," he says. "Frankenstein flows that are thrown together have increasing difficulty in actually getting there—they just don't converge. That is a very big set of changes for the industry, but I think we're on a good path for that."

To do this, the leading EDA vendors are finally starting to talk about the fact that they have been for some time opening their tools to top-tier customers and allowing those customers to add in their own pieces of technology to create customized, complete flows.

A large part of this effort has been assisted by the standards work that EDA providers have done in opening library and language formats to help customers stay state of the art with commercial tools and also provide a way for technology outside the common flow to connect with common solutions.

De Geus sees four fundamental trends in the EDA space, beginning with measurably improving productivity.

Second, design verification tools that perform simulation, test benches, assertions, coverage metrics and formal verification are coming together under a single technical umbrella greatly supported by the next-generation design language: SystemVerilog.

A third trend in EDA lies in the significant opportunities and investments in the design for manufacturing space as designs move to smaller manufacturing geometries. Finally, with the progression to much smaller geometries, there is an opportunity to put much more functionality on a chip. The challenge then becomes how to fill 100 million transistors. ■

Top Ten Electronic Design Automation Companies

2005 Rank	2004 Rank	Company Name	(Millions of Dollars U.S.) Fiscal Year 2005	2004	Change
1	1	Cadence Design Systems	1,329.0	1,197.0	11%
2	2	Synopsys	991.9	1,090.0	-9%
3	3	Mentor Graphics	705.2	711.0	-1%
4	4	ARM	418.7	367.0	14%
5	5	Magma Design Automation	145.9	113.7	28%
6	6	Agilent Eesof	N/A	79.9	N/A
7	7	Zuken	N/A	71.8	N/A
8	9	Ansoft	67.7	54.7	24%
9	8	Synplicity	61.9	57.0	9%
10	10	Novas Software	N/A	N/A	N/A
		Total:	**4,575.0**	**4,437.0**	**3%**

The 8th place ranking for 2004 was previously Verisity Ltd., which was acquired by Cadence in 2005.

Source: Electronic Business, Gartner/Dataquest and the EDA Consortium

Ann Steffora Mutschler is a senior editor at Electronic News

Center of Power Supplies Market STILL NOT TALKING

By Suzanne Deffree

Bruce Cheng, Delta Electronics

Diverse. Fragmented. Indispensable. These are all words used to describe the necessary but elusive power supply market.

"The power supply market is one of the most broad-based cross sections of the industry," says Chris Abarian, senior analyst at iSuppli, when asked to define the specific segment. "The power supply industry is probably one of the most fragmented in existence. It's almost like a mom-and-pop corner shop, just because it's so diverse."

Power supply is a subset of power management, one that many research firms don't bother to track as a stand-alone force.

Although iSuppli had no hard sales numbers for the specific segment, Abarian says the overall power management market is expected to grow 8 percent to 10 percent in 2006, from its approximate $21 billion worth in 2005. Overall, the firm forecasts strong first-half growth with some slight deceleration in the second half, before a "robust growth phase" in 2007.

Those predictions are outdone by growth from the power supply industry leader, Delta Electronics. The Taipei, Taiwan-based company on April 6 reported consolidated March sales of $257 million, representing a 48 percent increase over March 2005 and a 20 percent increase as compared to February's revenues.

The company's cumulative consolidated sales revenues from January to March were $686 million, a 49 percent increase as compared to the $462 million recorded for the same period last year.

Delta's outstanding growth, which it pegs at an 18 percent compound annual growth rate for the last 10 years, keeps it in the market's top position. The longtime industry leader saw total estimated revenue in 2005 of $1.292 billion, according to The Darnell Group. The research firm reports that Delta's 2005 sales were $430 million above those of the No. 2 player, Emerson/Astec Power, which had revenue of $862 million last year. Further, the company's results make up more than 20 percent of Darnell's reported total 2005 revenue for the top 10 power supply companies, which the firm estimates at just over $5 billion.

Delta's strong presence has a lot to do with its 35-year history and where it is based. Says iSuppli's Abarian, "Power supply is not a shrinking market, but this market is saturated. The real growth areas are in Asia."

"That's because it's a really mature industry, especially on the AC-to-DC side, and that's where the lowest labor costs are. Pretty much everybody knows how to make a power supply, so that was one of the first things to get established in Asia and take on the traditional European and North American power supply markets," he says, noting that the center of the market began to move from Europe and North America to Taiwan and China about 15 years ago.

Indeed, Delta's consolidated sales revenue for China operations came in at $213 million for March. Taiwan operations showed March sales of $186 million. The company did not return phone calls from this reporter.

However, Abarian isn't counting other regions out just yet. He notes that Asia won't have the lowest labor costs forever and that innovation in this market—despite its establishment and saturation—does spur growth. "You have a fair number of suppliers in the U.S. springing up with the sole objective of bringing to market DC-to-DC technologies," he says. ■

Top Ten OEM Power Supply Companies

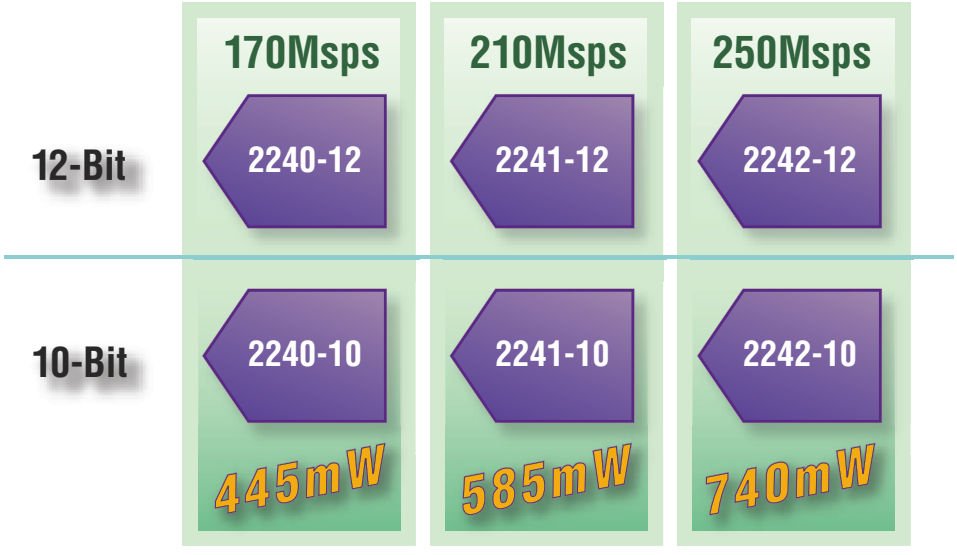
2005 Rank	2004 Rank	Company Name	(Millions of Dollars U.S.) Est. 2005 Revenue	Est. 2004 Revenue	Percent Change
1	1	Delta Electronics	1,292	942	37.1%
2	2	Emerson/Astec	862	878	-1.8%
3	3	Lite-On Technology	674	652	3.3%
4	4	Lambda	437	375	16.5%
5	5	Artesyn Technology	348	355	-2.0%
6	—	AcBel	330	N/A	N/A
7	6	Tyco	295	290	1.7%
8	9	FSP Group	293	227	29.1%
9	7	Sanken Electric	287	285	1.09%
10	—	Friwo	278	N/A	N/A
—	8	Phihong	N/A	273	N/A
—	10	Power-One	N/A	200	N/A

OEM Power Supply Sales Only: External AC-DC, Embedded AC-DC and Embedded DC-DC

Source: Darnell Group

Suzanne Deffree is news editor for Electronic News.

12-Bit, 250Msps ADC



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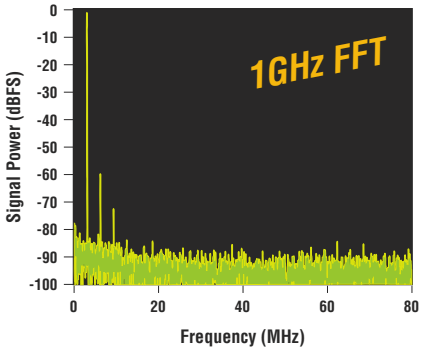

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The 'A Team' Stays on Top
OTHERS' FORTUNES SLIP

By Alan R. Earls

R. Keith Lee, Advantest America

Over the course of 2005, one thing became clear in the test and measurement space, the "A team"—Agilent and Advantest—was getting used to having its way. Meanwhile, others in the 2004 top 10, notably Teradyne and LTX, saw their fortunes slip. But Agilent started on top and stayed on top and is still big compared to almost anyone else while Advantest squeezed into a very solid second place. And with Advantest year-to-year growth rate of almost 103 percent in 2004 and nearly 36 percent in 2005, Agilent is doubtless casting nervous glances over its shoulder these days.

For now, though, things look pretty rosy at Agilent. About two-thirds of its revenue was generated outside the United States in fiscal 2005. And with 20,000 employees, the company has a global presence. Of its total net revenue of $5.1 billion in 2005, $3.3 billion was generated by the Electronic Measurement Group, $500 million came from the Semiconductor Test Group (which was sold early this year and is now called Avago Technologies), and another $1.4 billion came from the Bioanalytical Measurement Group.

"Agilent is definitely the No. 1 in T&M but Advantest has come up fast, especially in the past two or three years," says Kiran Unni, a program manager at Frost & Sullivan.

Unni says the key for Advantest has been moving away from just memory test, where its has traditionally been very strong, with something like 60 percent of the market, and into SoC and semiconductor testing. "The margins are small but [it has] managed to pass Teradyne in market share and revenue," she notes.

"Advantest has long been the industry leader in memory test," says R. Keith Lee, president and CEO, Advantest America. "Now, through the success of the T2000 open-architecture SoC test platform, we are also recognized as a leader in the SoC test market."

Indeed, Lee says cost-effective test and lowering the overall cost of system ownership are important to customers and are "the drivers of Advantest's commitment to providing innovative test and handling solutions." In particular, Lee cites the success of the T2000, which is an ATE platform based on the OPENSTAR specifications introduced in 2004 by the Semiconductor Test Consortium (STC). Lee says the future of the T2000 looks very positive. "We have good momentum and good interest from potential customers." Indeed, according to the company, sales of the T2000 since 2004 have been the primary driver for increased market share in the SoC sector.

Lee also cited another aspect of Advantest he says has contributed to the company's dramatic growth. "Advantest differs from most ATE companies because we view manufacturing as a strategic core competency and so we keep our manufacturing in-house." In turn, he adds, "Our manufacturing capabilities allow us to deliver high-quality systems that lead the industry in accuracy and reliability."

Looking at the future of the test and measurement industry, Lee says, "We are at the cusp of a mammoth business model change, caught between contemporary IC demands that can be summarized as 'more, faster, cheaper, better' and a traditional ATE business model that is no longer viable." In other words, says Lee, "the traditional ATE model fails in today's consumer-driven SoC device environment." Therefore, the key for the industry is to adopt an open architecture approach, he says.

Unni at Frost & Sullivan says apart from the huge success of Agilent and Advantest, 2005 also saw continued strength for Tektronix, though real impact beyond its traditional strength in oscilloscopes remains elusive. Watch for bio/pharm instrumentation to emerge as a continued source of growth, says Unni. While they are not yet on the top 10, Perkin-Elmer, Thermo Electron and Waters all made strong moves toward pharma and life sciences last year, she adds. ■

Top Ten Test and Measurement Companies

(Millions of Dollars U.S.)

2005 Rank	2004 Rank	Company Name	2005 Revenue	2004 Revenue	Percent Change
1	1	Agilent	3,800.0*	3,800.0	0.0
2	3	Advantest	2,230.0	1,640.0	35.9
3	2	Teradyne	1,088.0	1,800.0	-39.6
4	4	Tektronix	1.0	920.6	8.6
5	7	Fluke**	945.5	800.0	18.2
6	5	Anritsu	783.0	741.8	7.2
7	—	National Instruments***	571.8	514.0	11.2
8	7	Aeroflex	463.4	414.1	11.9
10	8	LTX	135.0	255.8	-47.2
		Total:	**11,446.0**	**11,326.1**	**0**

* Agilent revenues including only electronic measurement and automated test operations. Total test and mesurement revenue is $7.2 billion.

** Last year, only Fluke Networks was included in the ranking with 2004 revenues estimated at $225 million. The parent company estimates Fluke Network had 2005 revenues of $250 million.

*** National Instruments was not ranked last year because the data was not available.

Compiled by Movers and Shakers

Alan R. Earls is a freelance writer and contributor to Electronic Business.

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Agilent Technologies

Carlo Bozotti

New ST CEO Focuses on Reinvention, Asia

In early 2005, Carlo Bozotti took over STMicroelectronics when Pasquale Pistorio retired after 18 years as CEO. Pistorio's leadership had helped shaped the Franco-Italian chip maker into a global giant that was full of balance, nuance and variety.

Following Pistorio is hard enough. Bozotti, 53, is also tasked with restoring growth, cutting costs and invigorating the marketing of ST's innovations, which seem to keep coming. In short, his job is to reinvent Europe's largest chip maker to go after opportunities in a semiconductor industry that's turning more consumer-market-oriented than ever before.

But Bozotti has already seen ST go through several stages of reinvention. In 1977, shortly after graduating with an electrical engineering degree, he started with Italian semiconductor manufacturer SGS-ATES, which became SGS-Thomson Microelectronics and finally STMicroelectronics.

His experience along the way as top marketing executive in various geographies and as head of the memory products division seems well suited for his mission. Berlin-based freelancer Drew Wilson chatted with Bozotti about his goals for ST.

Q: What applications do you expect will drive revenue for STMicroelectronics this year?

Bozotti: The end of last year showed a positive trend in various market segments and applications. Growth is kind of generalized. We have a strong wireless environment despite seasonality—traditionally, wireless is very strong before Christmas. We also see a strong driver in anything that is a digital consumer product, new high-definition televisions or various kinds of set-top boxes. Automotive is stable and strong. Also, there's a recovery in anything that is for industrial applications.

Last year was difficult. Now we see a recovery in what we call the mass market, midsize and small customers. So, it is a broad recovery with several drivers. Most important is wireless, digital consumer and industrial.

Q: The shift of the semiconductor customer base from traditional telecom and computer to a more consumer-oriented one has been shaking up the traditional big-chip-company model. Some are spinning off divisions or going fab-lite. How has the industry shift affected STMicroelectronics, and how is your company responding?

Bozotti: Rather than a shift, it is a convergence of consumer applications in wireless, more multimedia features and products and applications that are embedded in traditional communications products. This is a very important trend. We are very well positioned to exploit the synergies between wireless and multimedia. Of course, the

consumer market is moving to digital. Digital and high-definition TVs are replacing traditional analog TVs. Portable applications in general are very strong—and not only with traditional wireless customers.

As for the fabless and manufacturing models, we believe that the balanced approach is the best-possible one. The biggest portion of what we sell is still manufactured internally, and what we outsource is the most standard technology. CMOS logic technologies are where a significant portion of our volume is outsourced. All of our proprietary technology such as embedded flash and everything we use for embedded solutions and systems integration we are manufacturing internally.

Q: Will the big-semiconductor-company model dominate?

Bozotti: Yes. Many very important customers require that their suppliers control manufacturing. Some of our customers, of course, are happy that we outsource a portion of manufacturing, but very important customers definitely request that we have clear control of our manufacturing assets.

Q: What phase is the company's restructuring program in now, and what are some ways ST will show the fruits of those efforts by the end of 2006?

Bozotti: The important program is the restructuring of our 6-inch manufacturing, the most mature technologies. We will migrate the bulk of these technologies and products from America and Europe to Asia—in our case, back to Singapore. We are completing the migration this year. We are closing two fabs in Europe. We have closed others in the recent past. When these two fabs are closed and the volume is in Singapore, it will affect our cost structure. We are starting to see it now. Quarter after quarter, there was a good trend in terms of improving our bottom line, and that will continue. There will be an acceleration of positive impact on the P&L after the two fabs in Europe are shut down.

Q: Could you give some color to STMicroelectronics' NOR and NAND flash memory strategy?

Bozotti: Important for us is access to this technology for wireless and embedded applications. We have proprietary technology in the area of NOR products, and we believe that scale is crucial. I've said on various occasions that we are working on exploring partnership opportunities to increase dimension of scale in this area. In the case of NAND, it's not important for mass storage but it is for focusing on wireless customers. We started with Hynix as a partner. In practice, we are sharing R&D, product and technology development and sharing those costs. In addition, we have a NAND initiative in China, a manufacturing joint venture that will start production the beginning of next year.

Q: The European Semiconductor Industry Association argues in a recent report that Europe is hosting fewer wafer fabs than other world regions, resulting in diminished potential for semiconductor innovation. Does it have a point?

Bozotti: The objective of the report was to compare the opportunities for government support in the area of 12-inch fabs between European countries and various Asian countries. I have to say that a very important element in manufacturing costs is related to the level of government support. Several Asian countries have been very competitive and helpful to STMicroelectronics. We contributed to the report to make this point.

A very important element in manufacturing costs is related to the level of government support. Several Asian countries have been very competitive and helpful.

We have a commitment in Europe to move on with our two initiatives. One is a partnership with Freescale Semiconductor and Philips at the Crolles [France] site involving R&D for advanced logic technologies. At the moment, we are ramping up the manufacturing volume together with our two partners. Partnering here is important in order to share R&D expenses. The second initiative we have in Europe is the 12-inch higher-volume facility for mass production for advanced technology in Catania [Italy]. With this commitment, we can also reconfirm our vision that the bulk of R&D for STMicroelectronics is and will remain in Europe. We have the bulk of logic CMOS in Crolles and the bulk of the nonvolatile and embedded nonvolatile in Italy. On the other end, product development is more spread out and sometimes much closer to our customers across the world. This is the way we are structured, and I do not

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Lothar Maier

Linear's a 'Proprietary' Place Where Everyone Knows Your Name

Linear Technology claims only 3 percent of the analog IC market, but its 40 percent profit margins get a lot of respect in the industry. Electronic Business *magazine Editor-in-Chief John Dodge interviewed Lothar Maier, who has been Linear's CEO since January 2005. He took the reins from founder Bob Swanson, who had been the company's only CEO since the company's founding, in 1981. Linear's products include amplifiers, battery management devices, data converters, voltage regulators and voltage references.*

Q: Is there something about high-performance analog that makes Linear so profitable?

Maier: High performance is high performance only if there aren't two other guys who can do it. The benchmark is that you are a unique provider of that product. Basically, 97 percent of our products are proprietary. For virtually all the products we have, there aren't any pin-for-pin replacements. At last count, we had more than 7,000 products.

Q: Linear netted $103.2 million on $265.1 million in revenue last quarter, which is typical for the company. Those margins are unheard of. What's the magic?

Maier: Linear is laser-focused on the high-performance analog sector. We don't participate in the more commodity part of the business. Our challenge is not necessarily to be ahead of our competitors but to be ahead of our customers. We try to meet with customers and understand what sort of needs they will have in the future, and we develop products for those, which makes us unique. It's one of the reasons we are able to maintain the margins.

Q: Isn't *proprietary* a scary word in the electronics or technology industries? Does that mean your customers don't have a second source for their products?

Maier: You have it absolutely correct. That's one of our strengths. On one hand, we have unique and compelling products. On the other hand, we have the ability to deliver proprietary products very reliably. We have a reputation for on-time delivery and short lead times, which are typically four to six weeks. That's in all market conditions. During bust cycles and boom cycles, we are able to maintain short lead times. Some customers may be a little uneasy about having proprietary products, but we win them over with our delivery and performance. We tell customers they are much better off having one outstanding supplier than having two poorly performing suppliers.

Q: As you look into 2006-07, what will be the hottest markets?

Maier: We don't necessarily build products for

specific markets, and we try not to get fixated on end products and markets. We don't say we are going to be the no. 1 supplier of power products to the cell phone market. This is not how we drive our business. The strengths at Linear are the diverse markets we sell into and that our products are diverse. Certainly, there are periods in which certain markets are stronger than others, so then there's a focus on the right ones. Our general sense of the overall electronics market is pretty optimistic. You don't have to thumb open any publication to see the mind-numbing number of consumer products out there. They tend to get a lot of attention, but they represent only 11 percent of our market.

More-exciting things are happening in other markets. The industrial market, where there's a movement to handheld battery-driven portable devices, represents 32 percent of our sales. The plethora of products you see in the consumer segment exists in many of our markets. Another is automotive. It represents only 7 percent of our sales but is one of our fastest growing markets. Automotive started with infotainment and navigation. Going forward, we see opportunities in LED lighting for headlights, taillights and interior lighting. We see opportunities in drive and brake by wire, in under-the-hood engine management and in sensors for monitoring predictive failure of components. Communications was 33 percent of our sales last quarter. That's a very important market for us, consisting of networking, telecom infrastructure and cell phones. What's happening in consumer electronics is happening in many of our markets.

Q: Give an example of a Linear product that cuts across multiple markets. What's your most versatile product?

Maier: We don't have the one killer app that really defines the company. What defines it is thousands of different products that allow our customers to differentiate their customers from their competitors. There's no swinging-for-the-fence type of product. A few years ago, there were things like white LED drivers. We were one of the first companies out with them. In many ways, they enabled a lot of these cell phones that have multiple-color displays. That was five years ago. That same LED technology has morphed itself for the automotive market.

Q: Whom do you see as your competition?

Maier: Generally speaking, we don't look at our competitors, because if you're looking at their products, you're already behind in the race. Our strategy is more customer- than competitor-focused. In many ways, we are unique in how we go after that. Our strategy is for our design managers and engineers to spend a large portion of their time with customers, trying to understand what their needs are and in which direction certain products are heading. They take that information back to the factory and integrate it into our new-product-definition process.

Q: You had nearly a billion dollars in sales five years ago, and that's where you are today. When the recession started in 2001, Linear's revenues started to drop precipitously. You were COO during that tough period. How did Linear weather the storm?

We don't look at our competitors, because if you're looking at their products, you're already behind in the race.

Maier: It was dramatic after 2001, when revenues dropped by half. What was remarkable was that we were able to remain very profitable even when our sales dropped. Return on sales dropped to 33 percent in our worst year, which is better than most competitors' best years. The structure of the company is such that even during a downturn, the company can remain profitable. Because Linear manufactures everything it sells, we can turn things on and off as the business grows or drops.

Q: Linear does everything itself, including design and manufacturing. Explain the rationale behind this unique business model.

Maier: People struggle with it, because they look for the one easy answer, the secret sauce. But it's not really one thing, because the company does a lot of things very well. We still manufacture. We design all of our own products. We've grown the company organically and not through acquisition. The way we do product definition is unique. We have a broad product offering in broad markets with a broad customer base. We have outstanding field application support. That's important, because most of our customers are very knowledgeable about digital but not about analog. We supply worldwide service for integrating our parts into their applications.

Q: Describe Linear's culture.

Maier: We are very much a factory-oriented company and still do everything ourselves. We don't subcontract

Continued on page 80

John Daane

Altera: It's a Simple Matter of ROI

Altera is one of the two dominant players in the relatively small but pivotal programmable-logic market. Although No. 2 in PLD sales, Altera has arguably grabbed the momentum from archcompetitor Xilinx, in part by asking what the appropriate roles of FPGAs and ASICs are in today's industry. EDN Executive Editor Ron Wilson spoke with Altera's president and CEO, John Daane, whose vantage point gives him a unique window into the interaction between semiconductor processes, the global chip business and systems design.

Q: Let's start out with the old FPGA-versus-ASIC question. You've been in both ASIC and FPGA companies, and you have both FPGAs and structured ASICs in your product line now. Are ASICs dying, or are both finding a place in the industry?

Daane: It's a simple matter of ROI. As the cost of ASIC design continues to go up, it is effective only for very high-volume products, such as games or cell phones. In many infrastructure areas, you no longer see the ROI for cell-based ASIC design. Programmable alternatives are sweeping into those markets.

Q: Altera recently moved aggressively to create a line of really low-cost, moderate-size FPGAs intended for use in higher volume production applications. In the future, will earnings growth for FPGAs come from big, high-margin devices or from new high-volume smaller parts?

Daane: Historically, FPGA vendors would have one die but would pin it out differently to serve different price points. But in 2000, we decided to continue with large, prototyping-oriented FPGAs and also to create a new class of low-cost vehicles for high-volume applications. It's a different proposition—to make low-cost vehicles practical, you have to focus on vertical markets and pull out features to get the much smaller die sizes that products such as LCD TVs could use. Some of these are opportunities for hundreds of thousands of units. Today, both the big prototyping FPGAs and the low-cost, high-volume FPGAs are important contributors to profitability.

Q: With low-cost products, is reprogrammability less of an issue?

Daane: It depends on the application. Some applications benefit from field reprogrammability to add features via download. But in the consumer market, the ability to deploy a design very quickly at low cost is more important. These people are trying

to serve markets with six- to nine-month lifetimes—but ASICs may have a two-year development cycle. A programmable solution may be necessary to get the product into the market. It's a time-to-market advantage.

Q: Are these low-cost devices becoming application-specific?

Daane: We would hope not. Our advantage—the reason we have superior ROI—is that we can design one chip and sell it to 14,000 companies. It's the combination of all those sales that provides the payback to fund development. We are trying to stay as generic as possible, by getting as close as possible to our customers, finding out what they do and don't want and targeting a single product to them.

Q: You've said recently that because of your high volumes on a mask set and your regular architecture, you can uniquely benefit from advanced processes. But you've also said Altera has more process engineers than any other fabless company. Is there a point of diminishing returns where it doesn't make sense for you to stay on the leading edge of process technology?

Daane: The next node brings you higher density devices and lower costs for existing device sizes. That allows you to displace more ASICs by providing more features and more-competitive costs. So we can continue to grow. For the foreseeable future, I see no reason why our use of advanced technology should slow down. In fact, in the last few years, it has accelerated—FPGAs used to lag on technology adoption; now we lead.

Q: If it ever did slow down, is there any other product out there that could be as effective as a process driver?

Daane: Because we have a very regular structure, it is very easy to detect defects and trace them back to a location on the die. And there are the volumes of very large dies—in any process generation, most of the transistors produced are in programmable-logic devices. We are much more dependent on yield than on wafer cost for our cost of devices. We have a stake in yield enhancement, and we need a partner that will invest on its side to continue improving its process technology.

There is a difference between us and some other companies in the business, though. We aren't eager to be the first to announce a new process node. We prefer to make sure the technology is stable before we lock the timing windows into the tools, because once you do that, you've made a commitment to the customers. Do the work up front, get a stable platform and then provide the silicon and the tools. Over the last several generations, we've been very repeatable in this regard—exactly on schedule—with what we committed.

Q: Today, FPGAs are doing things that used to require an ASIC, because functionality has shifted from fixed to programmable logic. Now, as RISC processor cores get smaller and faster, are we seeing another shift from programmable logic to software and to chips that may have clusters of processors rather than programmable logic?

We are trying to stay as generic as possible, by getting as close as possible to our customers and targeting a single product to them.

Daane: In Dr. Makimoto's Wave theory, when a wave brings in a new widget, the old technologies don't go away. Makimoto has said he thinks FPGAs will continue to grow strongly. His next wave, as customers try to reduce their costs and improve performance with their architectures, is application-specific standard products [ASSPs], perhaps implemented with structured ASICs such as Hardcopy. But the important thing is the design methodology. Companies that have succeeded with this ASSP wave have FPGA-like methodologies. In fact, they almost always prototype their designs in an FPGA, or a sea of FPGAs, before committing to silicon.

Now, today, there is discussion of using a sea of processors in place of FPGAs. Microprocessors are very good for their applications—DSP cores for number crunching, FPGAs for random logic. I don't see any one of those replacing any of the others. The question is whether you can create a vehicle that can do all three very well. I believe we have that.

Q: Are you saying it is easier to capture a design in an FPGA than in an array of CPU cores?

Daane: Exactly. Look at the IBM Cell processor and the Sony PlayStation 3. If it were easy to capture arbitrary functions in a sea of processors, there would be only one chip in the PlayStation 3. But, in fact, there is a graphics chip as well—a sea of arithmetic logic units may work well for a specific application, but it's not going to work well for all.

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Hector Ruiz

If Intel is San Francisco, then AMD is Los Angeles

At the turn of the 20th century, the most cosmopolitan city in California was San Francisco; Los Angeles was still a frontier outpost. But when the 1906 earthquake hit, a century ago, that tectonic movement shifted each city's relative prominence. There were other factors in that shift, too, but before long, Los Angeles became the focal point of business in the state—something no Californian would have predicted in March of 1906.

Now substitute Intel and AMD for those two cities. No huge temblor has rocked Intel, but it's been subject to a number of little ones: the cancellation of several microprocessor projects, a public blasting by its former CEO, running second to AMD in dual-core development. Who would have predicted that lowly AMD—which one of its employees compared to a chaotic team of 6-year-old soccer players—could suddenly surpass Intel?

AMD is a long way from enjoying Intel's hegemony—and the company has certainly had its own missteps in the past—but currently it's gaining in an impressive fashion. Much of the credit goes to Chairman and CEO Hector Ruiz, who took over from founder Jerry Sanders, moving from the chief operating officer position in 2002. In this Q&A, Howard Baldwin talks with Ruiz about how he kept the best and jettisoned the worst from AMD's corporate culture to make it a stronger competitor.

Q: It's always difficult to be the CEO following a company founder, and it seems like it would be especially difficult following someone as flamboyant as Jerry Sanders—not to mention that your low-key personality seems diametrically opposed to his. What's it been like following Sanders?

Ruiz: Taking over from a founder, you do have a tough time. I do have a different style than Jerry. I wanted to make sure that what I did would not be perceived as disrespectful of the work that Jerry did. He built a company, and he did it in an environment that was not easy. I talked to George Fisher, who took over the reins of Motorola from Bob Galvin [Galvin's father founded Motorola; Ruiz headed Motorola's semiconductor [business under Fisher] and other executives that I know. I made sure that I paid respect to the past while still taking AMD to the next level.

If you have a company built around the persona of an individual, the reality is that that persona is there in the culture. The key is [to] learn where it is and not ignore it. One thing that was very strong in the culture that I did not want to change was AMD's fighting spirit. The company has gone through some incredibly difficult times, and people did not bail out. That sort of culture was in Jerry's DNA: No matter how tough, you don't give up.

Q: What did you want to change about AMD?

Ruiz: There was a strong desire to be more of a follower in regard to the competition. People believed that if you could do everything the same way, just cheaper, you have a chance of winning. I didn't think it was working, and I became disillusioned with that idea. I wanted us to become a company where we could create our own future and do things that our competitor cannot duplicate. That required us to take a different view of what winning meant. Winning is not necessarily gaining unit share, but improving the quality of the business, of customers, of market share.

Q: And you've done that. AMD now has partnerships with all the major desktop and server manufacturers for its 64-bit technology, except for Dell—and rumors of a deal with that company surface regularly. How did you navigate from being the underdog to this position of strength?

Ruiz: The company was historically focused on consumer desktops, and the company was focused on the K8 architecture [code-named Hammer], trying to figure out how to get a K8 desktop into the marketplace. I asked, Why? Because that's where the volume is? I channeled the energy and enthusiasm into flipping the company upside down, making the server a higher priority. If our dream was to be a true industrial company, one not tied to Intel's fortunes, we had to do that. If we couldn't do that, we didn't deserve to be an independent company.

Q: AMD's 64-bit chip has basically shellacked the partnership of Intel and Hewlett-Packard with their Itanium chip. To what do you attribute this success?

Ruiz: Dirk [Meyer, named president and COO in January 2006] and Fred [Weber, former chief technology officer] had a vision of 64-bit computing and multicore technology that was already under way when I became CEO. It was just lucky for me. That said, there were three approaches that we took that were important.

First, it became clear to us that the market did not want [to upgrade to] Itanium. As one customer said, it was going to be a "supplier-induced" [rather than customer-driven] transition. Second, the computer industry is very complex; it relies on the success of many parts. A company needs more than just a good microprocessor; it needs an ecosystem of industry players that preserves the software investment companies have made. When we talked to customers and partners, [they emphasized that] preservation of that ecosystem was really important. Third, customers like Sun and users like Merrill Lynch wanted product features that were important to them.

Q: How did that manifest itself in the chip design?

Ruiz: We learned that power consumption of the architecture was significant, as was the ability to manage large amounts of data effectively. Therefore, that was how we designed Opteron's architecture. It appealed a lot to end users, and when they got their hands on the product and tested it out, it showed exactly that kind of high performance. They in turn put pressure on the OEMs to make sure the processor went into their product plans and road maps.

Q: How do you see multicore technology changing the industry?

Ruiz: In the next five to 10 years, it's going to be very powerful and more far-reaching than people realize. It opens up a lot of opportunities [because] finally, after years of research, a lot of capabilities that were invented for the mainframe are working their way down to the PC and server and open up a number of things: virtualization technology, improved computing utilization, security improvements. Sixty-four-bit technology has yet to scratch the surface [of all it can do].

Q: If Intel has always been a difficult competitor, what's behind the timing of your lawsuit?

Ruiz: We've known for a while that the way Intel has managed its customers was not right. As we were beginning to get traction on great technology like Opteron, we had to deal with it.

Q: AMD's R&D expenditures are up 50 percent since 2000. Why is R&D important to you?

Ruiz: This is going to sound counterintuitive. The market isn't growing fast, but it's huge. We were a small part of the market and had the opportunity to grow a lot. One of the things I felt we needed to do was to invest in R&D strongly to build the momentum to grow. We had to shoot ahead of the puck. If you look at our growth rate, it's been higher than the competition. I think it's paying off. But it'll level off—in the next three to five years, our R&D rate will be in the range of 15 percent to 16 percent [of revenues].

Q: What's left to work on?

Ruiz: I would love to be more of marketing whiz. Peter Drucker once said a great corporation has two things: innovation and marketing. I think we've done well in innovation, but I would like to be better at marketing our company. I'm not talking about hype or BS, but it's important for people to know our strengths and weaknesses, so they know whether to buy or invest. A lot of times I'll have an interview with an analyst, and they'll ask about our problems in manufacturing. But we haven't had a manufacturing glitch in five years. [I want to be better at marketing to make people] more informed about our products.

Q: How do you think you'll be remembered as CEO of AMD?

Ruiz: How I would like to be remembered is different from how I might be remembered. I think we put together a fantastic team of people. We took the best that was here and combined them with the best from outside. We're going to win by having the [right] number of great people, not the most mediocre people.

One of our employees told me when I first came here that the company reminded him of his 6-year-old and his soccer team. They're running all over the field, and one day they hit the ball this way and one day they hit it that way. Now, he said, he looks at AMD and sees a mature soccer team with a plan. I'm happy to have brought order to chaos. ■

Brian Halla

His Outlook for National Semi Has Never Been So Bullish

Brian Halla, chairman and CEO of National Semiconductor, sat down with Ed Sperling, editor-in-chief of Electronic News, *to discuss the future of the electronics market, where the new opportunities will be and where his company will play. Whether looking at the emerging markets of China, India and Eastern Europe or emerging applications such as medical, Halla likes what he sees.*

Q: What's the outlook for growth at National Semiconductor?

Halla: I fundamentally have never been so optimistic about the future in my career.

Q: What's driving your optimism?

Halla: The optimism is borne out of dramatic changes in the industry that drive semiconductor demand. We're now 40 percent of the content of iPods and BlackBerrys and all of these other devices that sell for $200 to $400. They can be easily replaced, so [consumers will] buy several. You add all of that to the video games and the [personal video recorders] that people are consuming right and left, and it's different from the past. The first boom cycle in the industry was driven by the replacement of ferrite core magnets in the back of mainframes with DRAM. We were a fraction of the cost of a mainframe in content. The second boom cycle was the PC kit, which was 10 percent of the cost of the PC. Now we're 40 percent of the cost of these consumer products, and we add to the differentiation more and more. There's demand just in the diversity of products that use semiconductor technology.

Q: What's that all worth in industry terms?

Halla: During the top of the dot-com boom, we got the industry to $204 billion. When the smoke cleared, we found that about $75 billion of that was still sitting on shelves in the form of semiconductor inventory. Nobody knows how big the industry got, but it was probably in the $100 billion-plus- range.

Q: That's real dollars instead of booked dollars, right?

Halla: Exactly. National Semiconductor found out there were 100 million phase-lock loops sitting on the shelves of distributors and in the form of finished handsets at Verizon and Sprint and the contract manufacturers and even the OEMs making the phones. What's different? We've got this

industry up to $250 billion sales out, on a run-rate basis. And there's virtually no excess inventory anywhere. It's below normal levels. The OEMs don't have a lot of inventory, the channel doesn't have a lot of inventory, and as far as we can tell, the demand for cell phones continues to increase up and to the right. There's a reason for that, and it furthers my optimism.

Q: What else drives that optimism?

Halla: The expansion of the market with the opening of China. There are 400 million middle- to upper-class consumers in China. That's four times the size of the equivalent [total available market] in the United States. And they love to buy brand-name items. If you go to Shanghai and stand in front of the fashion plaza at 3:00 on the Bund, you'll see young adults standing in line until 11:00 at night with a fully featured handset in one hand and a mocha latte from Starbucks in the other, and they're waiting in line to get into Gucci to buy a purse. Right behind that we've got India, and right behind that is Russia. One of our cell phone customers said their fastest growing market was Nigeria. All these emerging countries never had the time or weren't a factor in putting in the infrastructure for wired, so they go right to wireless and everybody buys a wireless handset. That bodes well for the industry.

All the science is at the atomic level. We're all just pushing atoms around.

Q: Are there other drivers?

Halla: When we've talked about what drives this industry, it's always been IT and consumer electronics. Now it's content. Why aren't we talking about medical applications?

Q: You're drawing the line on content. Isn't content also medical?

Halla: That's right. It could be surveillance. The content doesn't have to be a movie that comes out of Hollywood. It could be a webcam looking at every inch of highway from here to Tahoe so you know when to take [Route] 50 instead of [Interstate] 80. It could be the image that comes out of a [prenatal] ultrasound, which is so accurate they can determine the sex [of the fetus] these days. They send sonar into the fetus and the signals that bounce back get read. That's a tremendous application for us because we do precision amplifiers that have no noise over the entire temperature range. There's a new application.

Q: The content is a key piece, of course. Is the next step to be able to take all of these pieces, including content and mix them together in ways we haven't thought of—particularly pieces that weren't viewed as the same market?

Halla: In 2002, my intellectual property lawyer came running into the room and said, "Brian, you wouldn't believe what's happening down in Building 31." That's where we put on seminars for the engineers. He said our guest speaker was a professor in the mechanical engineering department at Berkeley who was talking about DNA molecules. His model was that in the old days, the scale of innovation happened at the size of an aircraft carrier. As the scale came down, it happened at the level of a car, then a laptop, then a chip. Now we're down in subnanometer. All the science is at the atomic level.

Q: So everything is at the quantum level?

Halla: Yes. We're all just pushing atoms around. Back up to 30,000 feet, how do you innovate in this industry? Typically, you have this mound of patents. National is probably the second- or third-largest patent holder in the state of California. Most of our innovation comes from patents that are written on top of the patents that already exist. If you take all the patents in science and technology and medicine and put them all together, you're going to see exponential growth in innovation for semiconductor technology. We're going through a MEMS phase right now, where we put little motors on chips. You can see those motors being replaced by DNA molecules, because they work the same as motors. There will be an explosion in demand for technology.

Q: Will it get to the point where the real value will be how those pieces go together?

Halla: How the pieces go together becomes the real value-add. The technology for medical applications exists at a chip level, but it's never been put together. For imaging, we put a camera together in a pill that you swallow. It shoots four frames a second. Let's say that pill has a temperature sensor on it, because tumors are typically hotter than the rest of the tissue around it. One way to prolong the battery in that pill is to add a temperature sensor so that when it hits a hot spot, it shoots 30 frames per second because that's where the tumor is and then it shuts off when the temperature drops back

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Roy Vallee

Avnet Targets Direct Markets Through New Logistics Business

Roy Vallee, CEO of megadistributor Avnet Inc., can truly say he's "been there, done that." In the nearly three decades Vallee has worked at Avnet, he's held positions ranging from field sales rep to president and chief operating officer. As CEO, he's navigated the $12 billion reseller through the worst downturn in the industry's history to a position where the company is expected to beat Wall Street earnings estimates in the current quarter. In 2005, Vallee put another feather in Avnet's considerable acquisition cap by purchasing Memec, a top-tier distributor long admired for its demand-creation business model. Avnet in 2005 also knocked longtime competitor Arrow Electronics out of the No. 1 distributor spot (at least for the moment—the companies have swapped the top two positions in the industry for nearly two decades now).

As the distribution industry girds itself for the July implementation of Europe's Restriction on Hazardous Substances (RoHS), Vallee spent some time with Electronic Business Senior Editor Barbara Jorgensen talking about the business climate, Avnet's latest business venture and what's he's thinking about in 2006.

Q: Avnet just launched its new unit, Avnet Logistics, within the past year. What market trends drove the development of this business, and how does it fit into Avnet's overall strategy?

Vallee: Well, in very round numbers, the distribution total available market (TAM) [indirect sales] represents about 25 percent of the electronics market, and the direct TAM represents about 75 percent. So, Avnet wants to grow, but we want to grow profitably. What we find is, as we engage with these typically direct customers, the larger the customer or the opportunity, the more difficult it is for us to achieve adequate levels of profitability as a distributor. On the other hand, we have this global logistics infrastructure; we have a global IT infrastructure in addition to that; and there is a need in the direct part of the marketplace for the same sorts of supply chain services that we provide in the distribution marketplace. But the economics won't allow us to serve that market profitably as a distributor. So it seems like a natural expansion for us, from an adjacent market perspective, to offer our global logistics, supported by our global IT, to become a specialized logistics provider to the technology supply chain as a way to profitably participate in the direct part of the TAM. And the interesting thing is the capabilities—global logistics and IT—we must have for our core distribution business, a $9 billion global distribution business in electronic components. We need those capabilities, so they will be invested in.

Q: So, unlike other supply chain services—most of which require the purchase of

components at the end of the day—this is a pure fee-for-service model? Hasn't the industry tried this before?

Vallee: We have developed some services revenue streams, such as Promiere [supply chain services], but we found that in the vast majority of cases, when we have a value-added service to provide to a customer who buy components from us, they typically want to buy that bundled. So we cost account for the service separately within our company, but for the customer, we do business in the way they want to do business. So, while we have built up our services capability and we have a services revenue stream, the majority of it is still embedded [as a components-plus-service package]. If your offering is really focused on the direct side of the marketplace—where Avnet is not the seller of the components—the revenue stream is fee-for-service. It's the same way you can say UPS or FedEx has a fee-for-service revenue stream.

Q: But how does Avnet remain cost competitive with logistics providers such as UPS or FedEx, carriers that are trying to move into specialized marketplaces?

Vallee: If you think about it, UPS started with trucks and FedEx started with airplanes, and then UPS moved into airplanes and FedEx into trucks, and then they both got into logistics primarily as a strategy to expand their transportation business. To accomplish this, they have moved into some industries that you would normally not think of as typical transportation markets. Now contrast that to us: We are in distribution; we buy components in volume and stock them in warehouses and sell them to a broad base of customers. As a result of this, we have developed this logistics capability where we are willing and able to go after the direct part of the market. We are still contracting with UPS and FedEx for the transportation part; the only overlap is who is actually going to run the warehouse. If you think about it in one simplistic way, UPS and FedEx are excellent box movers, and Avnet is world class when the box needs to be opened. Plus, there are peculiarities in electronics, like you must have an electrostatic-discharge-controlled environment; you must understand what the material is and whether there needs to be a physical value-add performed—like programming or assembly or marking or testing—before the device is shipped out the door. So, all our warehouses are vertically focused—back in the dot-com days, this would be called domain expertise; we are domain experts at the electronic component logistics function. I can't imagine Avnet owning trucks and planes. I would argue today that we are world class at managing a component logistics service center. And by the way, UPS and FedEx have been in and have looked at our operations, and they agree with us.

They'll look at other verticals—they are going into more warehouse service management—but I'd be very surprised if they went into electronics components. You take any end product and take any printed circuit board—think about how many manufacturers' products go onto that printed circuit board. Now think about Avnet's ability to deliver those components versus the possibility that all those suppliers would pick the same logistics provider to supply all the components in one box. Usually, UPS and FedEx service one manufacturer to one customer—Playstations to a toy store or a guitar to a guitar center—not multiple pieces in a single cart. It is the reality that in the component sector we don't ship finished goods. UPS and FedEx are adept at providing services for finished-goods industries.

Q: Shifting gears: How many years has Avnet been in China?

Vallee: It depends on how you think about it. We started in Hong Kong in 1995 and we went into Taiwan, and we began fielding salespeople within the PRC in the late '90s.

Q: But Avnet received some particular status that allowed it to operate within China, right?

Vallee: There are a number of ways we have been operating there. If you think over the 10-year span we have been there, we have been operating under a license from the Chinese government where we are described—and this term means something very different here—as a rep. What that means is, we are allowed to have Avnet-badged salespeople generating demand inside the country, but logistics are still done outside the country, for example, in Hong Kong. You can also apply to operate within a free trade zone, and that is also one way we have been operating for years. And as China has gained acceptance to the World Trade Organization, the opportunity to be a foreign-owned company operating inside of China is now opening. We are evaluating that. That may have an impact on our legal structure within China, but operationally we don't expect it would have much of an impact.

Q: Has Avnet's business in China developed as you first expected 10 years ago?

Vallee: I think China has exceeded our expectations by a substantial margin. When we started, we knew there was a fast-growing but relatively small indigenous market that we could serve, and we knew we had to be there

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Wim Roelandts

Xilinx: Looks to Web 2.0 for New Growth

Out beyond the boundaries of the electronics industry, there's a groundswell of support for a concept called Web 2.0. It's emblematic of technology's inherent optimism, of its belief that all you have to do is collect all the bug reports, fix the problem and upgrade to a new version that customers will embrace.

Web 2.0 essentially refers to the next generation of Web products, software and services that reflect lessons learned from what works on the Web (business-to-business connectivity) and what doesn't work (selling pet food). It also capitalizes on the network advancements that the first Web boom triggered (faster networking, more broadband).

But none of these advancements will take place without the electronics industry's contributions, and that's why Xilinx CEO Wim Roelandts—whose company designs FPGAs and other programmable devices-is so optimistic, as Electronic Business *contributor Howard Baldwin discovered. Not to mention Roelandts' own company's expansion into unexpected markets.*

Q: It was not necessarily a banner year in Xilinx's market segment. What happened?

Roelandts: Let's look at the big picture. From an industry perspective, we have had five really tough years. As far as I'm concerned, it's been a five-year recession. There have been some good quarters, but most companies haven't reached the numbers they had in 2000. That's normal. Bubbles create overcapacity, and it takes time to eliminate that overcapacity, because people over-invest and then they don't buy for a while. That's true of all big bubbles—to get out of the one in 1929, it took 13 years and a world war.

Q: If we're at the end of a five-year downturn, then, what do you see, going forward?

Roelandts: We're at the beginning of a new era in high technology, the second phase of the Internet. The Internet initially was driven by data: text and numbers. Now, there are more and different elements, such as voice over IP and video over IP. That's going to change the Internet's infrastructure. Characters are 8 bits. Voice transmissions are 64 kilobits per second. Video is some number of megabits per second. As all this becomes a reality, it'll change the high-tech industry. We have to strengthen the Internet

backbone by two to three orders of magnitude, and that's going to take 10 to 20 years.

Q: Where do you see some of this growth taking place?

Roelandts: Fiber to the home is one example. Japan has 200,000 new broadband subscribers per month. Once we have fiber to the home, we'll have to fill the demand for services. I think it will take a while to achieve, because nobody knows what services you can provide once you have voice and video to the home.

Interestingly, fiber deployment will be driven by company economics, not by the adoption rate. The telecom service providers realize that their voice revenues are going to go down because of VoIP, so they have no choice. They have a few years to reengineer their companies and get new revenues. NTT has realized that in Japan. That's also what's driving SBC's acquisition of AT&T and the proposed acquisition of BellSouth. It's happening almost independently of economic cycles.

Q: What else do you see affecting growth?

Roelandts: Another phenomenon is the digital convergence on the consumer side. This is a big change, because the PC was driven by corporations, which were the only ones that could afford $4,000 desktops. This new phase will be driven by consumers. Gadgets are going to be multifunctional and connected, and that will be driving some of these changes.

Cell phones were originally just communications devices. Now, you can take pictures and send e-mail with them. In the future, you'll be able to watch movies on them. That's evolving into more and more functionality sitting in those cell phones. All of that is based on connectivity and infrastructure. Most TVs will be replaced by high-definition television. Once you have that, they'll do more than just display movies—they'll be more interactive, with built-in storage for TiVO-like capabilities. A lot of new things will be coming, driven by consumers rather than corporations.

Q: But, just as the home has benefited from the PC revolution, won't corporations benefit somewhat from this new revolution?

Roelandts: Of course, and they already are. This kind of connectivity lets companies become more fragmented. Xilinx is a good example. We don't build chips, but we have partners that build chips. The amount of intercompany communication is huge. We have meetings; every night we get megabytes of data from our factories. With video over IP, we'll make videoconferencing from the desktop a reality.

Q: Does all that help or hinder programmable logic devices?

Roelandts: The trend in which OEMs are increasing their use of programmable devices is positive, in multiple ways. The world of digital convergence means more complexity. You can conquer complexity only with programmability. You can create ASICs to do that, but I'm not sure the human brain can handle that kind of complexity and make it work properly. With programmability, you can build a piece and test it and add another piece and test it again. In a world where multiple standards are coming together and possibilities are infinite, programmability is the only way to go.

The world of digital convergence means more complexity. You can conquer complexity only with programmability.

Advances in technology are also in our favor. The costs of doing ASICs are getting higher and higher, so that means more opportunities for programmable devices. In the infrastructure markets, programmable devices already dominate. People are still doing ASICs for density or performance; if you need that many gates, or gigabit performance, ASICs are still the only solution you have. But programmable devices have taken over for a lot of design and production. We are competitive in the advanced technologies—65, 45, 32 nanometers. The cost of doing ASICs is getting higher and higher, and no one can afford it. On the other hand, we can spread our costs over thousands of customers.

Q: The digital convergence we were talking about before works in your favor as well.

Roelandts: That's right, because convergence creates an infinite number of permutations. When you're a designer, what features do you put in? When you're designing in the consumer space, it's a three- to six-month design cycle and a nine- to 12-month construction cycle. It takes 18 months to do an ASIC, so that doesn't work for you.

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Harold Hughes

Legal Battles a Way of Life at Fiesty Rambus

Following years of legal squabbling over its patents, Rambus is often viewed as the bad boy of the electronics industry. After all, what other company gives the same Web billing for its legal press releases as its does for its earnings and financial ones? Indeed, Rambus doesn't shy away from a fight and believes that if you use a high-speed memory interface in your product without a Rambus license, you're probably infringing on one of its nearly 900 patents or patents pending. Rambus in late April won a $306.5 million judgment against Hynix for patent infringement. To understand Rambus' DNA, consider that about 28 percent of its costs last year were from litigation—slightly below what it spent on R&D. In 2005, the company earned $33.7 million on $157.2 million in revenue. Electronic Business *Editor-in-Chief John Dodge interviewed CEO Harold Hughes about Rambus' business model and his view of litigation.*

Q: Is Rambus an IP company like ARM?

Hughes: That's hardly the worst comparison, but they have a different model. Their core [strategy is] through a licensing agreement, and [parts] are manufactured somewhere else. Our market strategy is more just pure licensing. We are an IP company, but how we deliver IP goes to opposite ends of the spectrum. In some cases, we deliver IP through working with customers by providing engineering. With the [yet-to-be-delivered] PlayStation 3, the IP is very, very complicated. [Helping to] implement [our technology] is a key strategy. There are times when our IP was developed a long time ago and that IP has [just] worked its way into applications. Needless to say, that generates a great deal of heat before the light comes through.

Q: What do you mean by that?

Hughes: Someone who's implementing a complicated high-speed interface can see the value of the patent and license. Why some of the licensing issues become a problem is that for quite some

time, people assumed that Rambus was dead and that our patents would never be held valid. That technology was implemented broadly significantly after we invested [in] it. Much of the XDR and DDR memory interfaces were developed by us in the early '90s and are just finding their way into consumer applications. We have valid patent rights there, and it's our responsibility as the keepers of this company to return value to the shareholders.

Q: Is the company primarily made up of engineers?

Hughes: We are significantly engineering, which is roughly divided into two groups. There is a subset developing technology that won't come to market for seven to 10 years. Often, I will attend meetings where I have almost no idea what they are talking about. The larger segment of engineering people implements our technology. It's exciting because the [engineers take] a great deal of pride [in the technology]. The unfortunate side is that the patent process and patent legal process is such that [the technology] can be tied up [in litigation for] quite some time. When you're talking numbers of significant magnitude, the other side is highly motivated to push [litigation] out as long as possible. So we have a significant legal staff and both internal and external lawyers. And we have marketing and salespeople.

Q: How many lawyers do you have?

Hughes: Several, but the bulk of the [legal] spending is for outside firms [Rambus spent $38.3 million on litigation in 2005]. We are blessed to have wonderful attorneys, and they pick up on some of the passion the company generates. They get a bit frustrated in representing us, given how difficult the process is. My life is very schizophrenic. I go from an engineering meeting deciding where we are going to put our engineering dollars [to a legal meeting]. A large part of my day is spending time with my general counsel. We are always under great pressure to get more deals done. We have more business there than we can do. That becomes very difficult, because saying no to customers is something they clearly do not like to hear.

Q: How many lawsuits are going on now?

Hughes: There are three with the primary memory manufacturers: Samsung, Hynix and Micron. They cover different products and different constructions of agreements in the past. Many of them would be patent cases against the DDR-level product. There's a patent case against DDR2-level products. There are [cases dealing] with price fixing. The FTC action by the government has been going on for quite some time [since June 2002, the FTC has charged Rambus with anticompetitive behavior and deception relating to its involvement with the JEDEC standards consortium].

Q: What was the impact of the Hynix victory in April?

Hughes: It's the first time we've been able to present [our side to] a jury. We got back resounding acceptance of our contention that they were valid patents and were infringed. We had to overcome a large number of hurdles just to have a jury trial. This is the first time we officially got to bat…and [we got] good wood on the ball. This is a great step to transition Hynix from a litigant to a customer and licensee. We're trying very hard to get everyone licensed.

This is the first time we officially got to bat [in court and we got] good wood on the ball.

Q: Are you emboldened now?

Hughes: No. We thought all along we would win a patent case if we got to it. We're not anxious to file new litigation. Why would we be? We think that rational businesspeople can come to a reasonable conclusion.

Q: What is the essence of these cases?

Hughes: You have to separate what we allege and what they contend. We believe we created the technology that has found its way into parts they manufacture but refuse to pay us a royalty for. There's that aspect to it. They allege certain things that our conduct was such that [they] should have the rights to the benefits of our IP. We would really love to work with some of the DRAM manufacturers to create wonderful products. Obviously, our engineers are always a bit stressed when we're having to take legal actions against some of the memory suppliers. You've got to do what you've got to do.

Q: How many basic technologies does Rambus have?

Hughes: Much of what [we] do is build upon previous

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Katsuhiro Tsukamoto

Renesas Expands Design Centers in Vietnam

Renesas Technology is positioning microcontrollers and its SoC business as core competencies, aiming to get back to growth. To do so, the company decided to suspend the development of its next-generation NAND flash memory. Renesas' new president and COO, Katsuhiro Tsukamoto, spoke to Takatsuna Mamoto, of Reed Business Information Japan, about his plans to boost the company's position in the semiconductor industry.

Q: What are your plans to strengthen your microcontroller business?

Tsukamoto: Our microcontroller products are classified into three categories: the SuperH [SH] family, for high-end applications; the M16C, M32C and H8 series, for midrange applications; and the R8C, for low-end applications. These products are covering a wider variety of applications.

Our core competence in the microcontroller business is to integrate flash memory. Two types of flash memory cells are available: the MONOS and HND architectures. For high-end applications, MONOS technology is used in flash microcontrollers, featuring 100-megahertz operation and fast data readout. For midrange and low-end applications, HND technology is used. Also under development is a low-priced version of MONOS technology for low-end applications.

Q: What do you think of MRAM [magnetic RAM] and other new memory technologies?

Tsukamoto: We are doing a feasibility study of embedding MRAM and ovonic [phase-change] memory into microcontrollers and developing them jointly with Hitachi and Mitsubishi Electric, both parent companies of Renesas. The new memory technology will be available around 2010, along with improvement of existing technologies and innovative development.

Q: How are you advancing your SoC business?

Tsukamoto: We are focusing on three areas of SoC development. The first is PC peripherals and AV device applications such as video- and image-processing chips for digital televisions and DVD recorders.

The second area is mobile phone applications. Our application processor, SH-Mobile, is positioned well in the Japanese market. Under a joint project with NTT Docomo, we developed an IC chip integrating W-CDMA and a GSM baseband circuit. A first mobile phone integrating the chip will be shipped in the summer of 2006. We will expand the chip business globally, including baseband chips. The third area is automotive. Renesas' SoC integrating an SH core has a market share of 60

percent in GPS car navigation globally. This is one of our hit products. As a result of this chip, we will expand our automotive SoC business. Also, we are focusing on dedicated ASICs for digital information devices, including digital still cameras, printers and multifunction printers. The products are manufactured with 90-nanometer leading-edge technology, and they are getting popular.

Q: Many engineers are required for SoC development, aren't they?

Tsukamoto: In Japan, we are shifting memory designers to the SoC design team. We also have design centers in several foreign countries. In Vietnam, for instance, we set up a design center one year ago. Currently, it employs 80 people. In the future, we will hire graduates from electronics departments of local universities to increase our number of designers to between 500 and 1,000 people. The Vietnam design center handles a part of hardware chip design. Those designers will design whole chips soon, I hope.

We also have design centers in Beijing and Suzhou and have done designs of locally customized microcontrollers for the Chinese market since 2006. Our other design center in China, for application technologies, is in Shenzhen.

Our other foreign design centers are in London and in Düsseldorf, and they design automotive IC and smart card microcontrollers. In France, a design center handles baseband chips designed for GSM mobile phones.

Q: How large is the impact of the newly developed 3G mobile phone platform?

Tsukamoto: We recently announced the single-chip SH-Mobile G series with dual-mode mobile phone capability as well as a basic platform installed with basic software-operating system and middleware. The platform enables cell phone manufacturers to focus on their software development to differentiate it from competing systems, leading to shorter time to market.

The single-chip IC is being jointly developed with NTT Docomo, and the platform is being jointly developed with Fujitsu, Mitsubishi and Sharp. With the platform, we can expand our business to system design from just IC design. ■

Bozotti *continued from page 63*

intend to change this strategy. It's obvious that most mature technologies migrate to Asia so companies can become more competitive. But with these advanced fabs, I think we can be very competitive in Europe.

Q: What is STMicroelectronics' most difficult challenge in 2006-2007?

Bozotti: In products, it is migration from a customer solution and ASIC products into platform-complete solutions we can offer our customers. Not just silicon but also firmware, drivers, application software. This migration from products tailored for one specific customer to a solution with which we can cover the requirements of a wider base of customers is both a challenge and an opportunity. It means more-expensive R&D and more significance in terms of software content. Time to market for all of these things is also an important consideration. We believe we have all the ingredients to transform these challenges into opportunities and faster growth. We will make sure we can reach the market before our competitors.

Solutions will be for a lot of new things: digital and high-definition TV, wireless infrastructure, application processors, nomadic applications, computer peripherals, and set-top boxes. We will do intensive R&D and also make higher, margin products, embedding a lot of application software. It's a very important element of our strategy.

In manufacturing, we will go faster to Asia while establishing advanced 12-inch fabs in Europe.

There's a sales and marketing challenge in Asia, especially in Japan, where our presence today is limited. We have good market share in the automotive market segment, and we want to expand. In China, where our volume is very significant, we are the No. 3 supplier. We do half a billion dollars per quarter in China. The challenge there is not only to grow with European and American customers but also with local customers that will become very important elements of the market. We recently restructured in Asia and China. That means more focus, more attention, with headquarters in Shanghai.

The dimension of scale in flash memory manufacturing is also a major challenge. These are the areas where we are focusing.

Q: You've been CEO a little more than a year. What has been your biggest surprise?

Bozotti: There's not really a significant surprise because I've been in this company for so many years. The greatest thing is the understanding of opportunities we have at ST and seeing all of them materializing. We are back now, gaining market share at a very significant rate. STMicroelectronics has a new CEO but also, in general, a change of generation in the company and a lot of new upper management. Rather than say "surprise," I'd like to define this CEO position with excitement. Opportunities are there, and we are all very motivated and ready to fight for very significant improvement. ■

Maier *continued from page 65*

anything out. We grow organically and have never done a significant acquisition. We can do it better by doing it ourselves. When you do a lot yourself, you typically end up with a better product in terms of performance, service and quality.

Q: What have been your biggest challenges?

Maier: One of them is to grow the company and maintain the profitability we've historically had. With a billion dollars in sales, we still represent only a small part of the overall analog market, which is $30 billion to $33 billion. Another of our biggest challenges is having more product ideas than we have people to go after them.

Q: What are your goals as you look ahead, and where do you see the company in two to five years?

Maier: Our focus is to continue growing. The company has historically been able to grow its sales 20 to 25 percent a year.

Q: What are the biggest impediments to meeting that goal?

Maier: I don't see a lot of external threats. As the economy gets stronger or weaker, that's a macro effect that affects everybody. As long as there is demand for more electronic devices, the business will continue to be strong. We're optimistic that we're going to able to grow as we have in the past.

Q: What is your customer mix? Is it the 80/20 rule, where 20 percent of your customers represent 80 percent of your business, or is it more spread out?

Maier: We have 15,000 customers, and no one customer ever represents more than 10 percent of our sales. We tend to have a very broad customer base. We have big customers such as Cisco Systems, Apple Computer and Samsung. We have the large electronics buyers, but again, our customer base, just like our products, tends to be very diverse. ■

Daane *continued from page 67*

Q: Let's explore the Neos phenomenon further. The big FPGA player fell in, and then out of, love with the idea of embedding a hard CPU core in an FPGA. As it was doing that, the idea of soft CPU cores took off. The soft cores take up more space and are considerably slower, so why did they get so popular?

Daane: As you move up in density, you need to integrate new features. We were at the point where we needed to integrate CPU capabilities. Our idea was to put in a high-performance CPU and its peripherals. At the same time, we introduced the soft processor. I think the world assumed that nobody needed another instruction set architecture and that the soft core would fail while the hard core succeeded. The opposite happened—the hard CPU cores have failed. To begin with, the hard CPU took up valuable die area, increasing cost. But you couldn't make the CPU in an FPGA process run as fast as a dedicated CPU chip. We ended up with higher cost and lower performance than we would have if we'd simply used a CPU chip with an FPGA. It doesn't make sense.

So we refocused on creating interfaces and peripheral cores that would work with high-end microprocessor chips. And at the low end, we found that people looking for low-cost, low-performance processors were quite willing to adopt a new instruction set. We made it easy not only to use the CPU core but also to generate a whole microprocessor subsystem automatically. It works extremely well for a lot of embedded applications.

Q: Do you see a time when you will just throw in a few hardwired Neos cores on the die?

Daane: We've looked at that, both for users and as a way of implementing some internal functions for ourselves. The Neos core is very small. In fact, it's so small that it's the peripherals, not the core, that start to use up logic elements. Embedding a hard Neos core wouldn't make that much difference in the size of the customer's design. So we've chosen not to embed one. But we keep looking at it.

Q: Are we going to see platform chips trying to include programmable logic on their die so they can span a wider range of applications with a single chip design?

Daane: I'd argue that it's very difficult to include a programmable element. Not only do you need the hardware IP but you also need the tool suite. That's a significant investment for any ASSP company. Keeping a programmable device as generic as possible is the better approach—the right features at the right price points. It's probably the best approach in today's market of escalating design costs. ■

Halla *continued from page 71*

to 98.6 degrees [Fahrenheit]. You have to know how a tumor works to apply semiconductor technology and sensors to that particular application. It's the ability to know how to use the technology. We're working with a few universities that won grants from the National Science Foundation to put chips on retinas to cure macular degeneration. We had them in for a brainstorming session. They said you can't put the chip on the retina because the die makes a cookie-cutter impression on the retina and we'd have to suspend it out in the middle of the eye. We told them that with back-grinding technology, we could make the chip flexible so it would conform to the surface of the retina. They said the other problem is that when the body senses heat, it will flush the area with fluid to protect it. That's why you swell up. In the eye, when it's concealed, the body can't get fluid to it so it goes crazy trying to fix it. There are simple inductive heat pumps that can take heat off the chips. We've had that technology for 20 years in semiconductors. It's taking technology that exists and using it in new ways.

Q: Do companies understand how to take advantage of these developments?

Halla: That's a tough one. When I kicked off the strategic business planning conference this year, I said, "I want you to tell me what the world looks like three years down the road and around the corner, and how do we intersect with the sweet spot of what the market needs. And don't assume it's the leaders you know today who will be the leaders three years down the road." What came back was interesting. It's almost impossible today to predict the next iPod or "CrackBerry." But what you can do is predict with 100 percent accuracy that if it's portable, you want a longer battery life. If it plugs into the wall, you want to suck the least amount of juice out of the socket. We can look at ways to continue to reduce power.

Q: So let's step back a bit and look down the road three years. What do you see?

Halla: When we look three years down the road we see better displays, better audio, better battery life, better integration. We're doing things like PowerWise [energy efficiency technology]. There are logical extensions to PowerWise where we can continue to increase battery life. It's really more and more analog. That's the differentiation. ■

Vallee *continued from page 73*

because of its relative importance inside of Asia.

At the time there was some offshore manufacturing taking place inside China, but we had no idea how massive the shift of operations from North America to inside of China would be. Later on, we were able to acquire a business that had done a very good job—Sunrise, which we acquired in 2000. As the domestic market was growing, and as low-cost manufacturing was rising at very rapid rate, we were able to substantially increase our investment and acquire a team of local people who could help us penetrate both the indigenous market and the global transfer business. So today, we believe if you look at electronic components the way we do—excluding microprocessors and DRAM, which is part of our Technology Solutions Group—in the semiconductor business, we believe we are now the largest components distributor in China, which is the fastest growing market in the world. And so I have to say with hindsight it has exceeded expectations.

Q: Moving on to another geography, what is the most significant impact that Europe's RoHS has had on the distribution channel and on the way Avnet has to conduct business with suppliers and customer?

Vallee: That's actually easy—the biggest one to me has been the information management piece. The whole issue about "Does this supplier have separate stock-keeping units [SKUs] or not, or how the parts are designated and what parts are complaint and which aren't, to how we steer customers toward complaint bills of material"—there has been a massive information management challenge that we have tackled in every region of the world. We have either acquired or built databases; we've had to ensure that information is communicated to our warehouses, and we have felt the need to become a leading educator of our customer base. We do what we can to make sure our customers are ready for this conversion.

So No. 1 on the list is information management. No. 2, there is a physical dimension to this: We have to make sure when an order goes into any one of our warehouses, if it's for compliant material, we ship compliant material. What that means is segregation of compliant material from noncompliant. That has meant an increase in the number of bin locations in order to serve the same revenue stream. So when you think about a few hundred thousand SKUs in our warehouses and think about potentially two locations for every one, that is a massive logistics challenge. By the way, let's see UPS or FedEx handle that. ■

Roelandts *continued from page 75*

Q: What does the PLD market have to do to compete in this arena?

Roelandts: At Xilinx, we have a strategy based on continuous innovation. The structure of the FPGA has changed, but we believe that the industry is still in its early stages. Five years ago, you just did place and routing with FPGAs. Now we're really hybrid devices—half programmable, half ASIC—and we're doing gigabit transceivers and DSP cores now. That gets us closer to ASIC equivalency faster. Both the evolution of technology and the semiconductor market evolution favor programmability and programmable logic. We see that in our volumes. At 150 nanometers, we got order rates of 100,000 per year. With 90 nanometers, we're getting 1 million units per year ordered regularly. At 65 nanometers, it'll be 3 million per year. With every generation, we become more competitive, and this evolution allows us to enter more markets.

Q: What are you spending on R&D to support this?

Roelandts: Currently, we're spending 18 to 19 percent of revenues on R&D. That's up every two years. In 1999, it was 13 percent of revenues, then 15 percent, then 17 percent. The 19 percent figure is more temporary; we're trying to get it back down to 17 percent.

Q: Are you looking at any new markets?

Roelandts: The big one for us is the automotive market. We hesitated a long time before going into it, because there are such extreme quality requirements, price pressures and long production cycles. But the car industry realizes that most innovation will be electronic, so it is driven by convergence as well.

It understands that consumers in cars want the same capabilities they have at home. The other side is safety features, which are really interesting. Some of our chips are used in speed control situations, keeping the car from getting too close to the one in front of it. But one of the most interesting applications I've heard about is a camera that uses our DSP core to watch drivers to make sure they stay awake and sounds an alarm if they don't. A lot of accidents happen when people fall asleep, but the device has to understand whether the driver is really falling asleep or just blinking. There's a lot of DSP processing that goes on, and it requires a lot of computing power.

The companies that can take advantage of these new capabilities in the electronics revolution will be the big winners. That's why programmable devices are becoming more exciting. ■

Hughes *continued from page 77*

inventions. It would be difficult for me to categorize precisely beyond that. The key thing that [we] are focused on is high-speed interfaces.

Q: Does Rambus have competitors? Is there a choice in high-speed memory interfaces?

Hughes: It has to be broken into two camps. There are certainly firms such as Intel or IBM that have high-speed interface people. That's the first.

Q: So, is homegrown technology your biggest competitor?

Hughes: The question is, can they do it without our IP? There are capable firms such as Intel that can do high-speed I/O work. Intel is licensed on our technology. Since they're licensed on our technology, that they're using [high-speed interfaces] is not currently a problem. People with internal high-speed I/O design capability that aren't licensed, I suspect, have a problem.

Q: So, does a company go the homegrown route at its own peril? Are there any other third-party firms out there selling third-party interfaces?

Hughes: Whether they could or not is somewhat academic, because they'd have to have a license from us. Think of the market dynamics. If you're talking high-speed interfaces, you're talking about a very important product. It's unlikely that someone with that internal capability would be enabling its competitors. To the question of merchant suppliers as an alternative to us, I could not tell you who that is or if [they] exist. If they do, I suspect there is a licensing issue.

Q: What about the perception that Rambus is trying to succeed as a company purely through litigation? Are you reconciled that the company might be vilified in the marketplace?

Hughes: I'm reconciled to it, and I'm not sure if all the marketing money is going to affect it. At the end of the day, what we need to do is win in court. Rambus is justified in defending its patents. If you win in court, it says Rambus owned them and the others didn't and should have taken a license. The frustration is not necessarily that you have to go court. The frustration is that you need to start that as a young man, because you may not [see a payoff] until you retire. ■

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increase in performance compared with Intel's Core Duo processor (formerly called Yonah), Smith says.

"With Merom [available] in the second half of the year, this allows us to bring dual-core capability in notebooks and get improved performance," Smith says. He points to five hours of battery life for a notebook with the new dual-core processor.

"I think what this allows us to do is continue a leadership performance in notebooks and still have [technology] that will be ready for the [Microsoft] Vista adoption, which we think will happen in the beginning of 2007," Smith says.

AMD is also touting a new core that's designed from the ground up to be 64-bit and multicore, explains Margaret Lewis, director of commercial solutions marketing at AMD.

"Moving forward, we saw it wasn't going to be a world where 32-bit was the answer. Especially in terms of performance, in terms of power—we came up with an architecture that supports 64-bit to support multicore and also had an architecture so it could move," she says.

The road map includes Opteron, Athlon and Turion, the company's chip for the mobile market.

David Rooney, division product manager in the mobile division at AMD, says that the company's Turion 64 chip, which was introduced in March 2005, will play an important role in the mobile market. "The notebook market is a very important market for AMD," Rooney says. "The low-power design [of Turion] is really aimed at the thin-and-light market."

Intel has a lead in the consumer PC market, including notebooks. AMD has made strides in the server market. "The server market is the one that has caught everyone's attention," Lewis says, adding that AMD controls more than 40 percent of the server market in the United States.

The biggest challenge for AMD, Lewis says, is for customers to see repeated AMD design wins over Intel. "People need to continue to see repeated success from our road map. They need to continue to see that we will deliver innovation," she says.

Suffice it to say that all companies in the microprocessor market are looking for a piece of several hot revenue spots: video games, servers, desktops and the mobile market.

IBM Microelectronics, for instance, saw its revenue skyrocket 138 percent in 2005 compared with 2004, according to iSuppli's rankings. Part of that jump can no doubt be attributed to its role in supplying microprocessors for Microsoft's Xbox 360.

As consumer electronics users and business users demand the ability to perform multiple concurrent tasks on their cell phones and computers, look for multicore to be the next big wave. The multicore market, in fact, is set to explode, according to iSuppli. Shipments of multicore processors are predicted to grow to 638 million units in 2015, up from 14.8 million in 2005, it says. ■

Debra Bulkeley is executive editor at Electronic Business.

Sujeet Chand

Rockwell's Future Rests on Diversity of Electronics

Like most other technology-driven industries, the industrial automation and controls sector is at a crossroads. Globalization and customer demand for flexibility and mass customization are driving a need for integration between the plant floor and key enterprise business systems. Companies in this space are examining a range of technologies and solutions to help in that convergence.

Milwaukee-based Rockwell Automation, with $5 billion in revenues and more than 21,000 employees worldwide, is clearly one of the leaders in this sector. The company has identified five key technology pillars that will help shape the next generation of industrial control products: controls and diagnostics; communications capabilities (including RFID and wireless); alternative materials; high-reliability software (including Web services); and finally, electronics with a greater reliance on commercial, off-the-shelf components.

The impact of these core technologies on future manufacturing systems will be significant. Expect to see highly flexible and reconfigurable control systems that can morph to meet the need to make manufacturing products that differ slightly according to customer requirements. Look for high levels of integration between manufacturing and key business systems, thanks to the adoption of Web standards. And prepare for an emphasis on optimum asset utilization and lower costs, driven by new self-diagnostics and maintenance features, which will also aid in making systems more environmentally responsible and secure.

It's a wide berth, but one that Rockwell Automation appears to have a handle on. Electronic Business *contributor Beth Stackpole recently talked with Sujeet Chand, senior vice president and chief technical officer at the company.*

Q: How are electronics playing a greater role in the industrial controls sector, and how do you envision that trend in the future?

Chand: The industrial controls sector has five core technology clusters, and electronics is one of the five. That hasn't changed in the last 10 to 15 years, and I don't see it changing for the next 10 to 15 years. Electronics will continue to be extremely important to us.

There are two key trends. First is a transition away from using nothing but ASICs to also using commercial electronics. Ten years ago, the trend was to develop an ASIC for every function we did. The feeling was that commercial electronics did not have the performance, nor were those components robust enough for what we needed. Today, commercial processors have evolved, particularly for embedded applications, so more and more of

these functions can be taken care of by commercial electronics. Before, I'd have to develop a custom ASIC interface to Ethernet—today, I don't have to do that, because processors support Ethernet natively. With such standardization, commercial electronics are supporting more and more of the functions we used to have to deal with by using ASICs. The general increase in processing power—Moore's Law—is also helping us.

The second trend is the growing diversity of the electronics we use today. In the past, we'd use primarily commercial processors or ASICs. Today, and in the future, we'll use system-on-a-chip and microelectromechanical systems technologies. MEMS, in particular, are going to be very important to sensing applications. So instead of just processors, memory and ASICs, we're looking a range of different types of electronics.

Q: Does software or electronics play a greater role in how Rockwell and other automation controls companies address emerging trends?

Chand: It's really a merging of both. The best solution is one that marries the right software properties with the appropriate electronics. If we mess up or overuse the software side or the electronics side, we'll have a system that won't be competitive. Moving forward, we're designing software and electronics together to build differentiation with our products.

Q: Two important trends in manufacturing are integrating the factory floor with mission-critical IT systems. What's driving those trends, and what role will electronics play?

Chand: Driving the need for integration between the factory floor and mission-critical IT systems is better management of the supply chain to meet just-in-time needs. The idea is to match production with demand. The only way to do that is to track real-time production in factories and match that with the supply chain. If you treat the factory as an isolated enterprise, you won't have real-time supply chain management. Also, flexible manufacturing—the idea of using customer requests to change production on the factory floor—requires integration between ERP and factory systems.

Electronics come into play here, because all the data moving between the factory floor and the ERP system has to be run through information servers and a data retrieval system. Devices and controllers on the factory floor have to have integrated support for such communications. Networks such as Ethernet, DeviceNet and other buses will have a home in these things, and there's a need for commercial processors that support those communications standards on the processor core. That, together with field-programmable gate arrays, will give us the option of connecting to Ethernet and other networks. Thus, electronics play a key role in enabling these communications along with the information retrieval systems.

Q: Rockwell talks about driving a second wave of productivity out of the plant floor as a major trend. Where do electronics fit in?

Chand: The first real wave of productivity involved lean initiatives; the second has to do with getting more productivity out of existing assets. In that vein, customers are looking for better diagnostics and prognostics for predicting when machines will go down, for quickly diagnosing failures and quickly repairing systems so there isn't much waste. This translates to a need for more embedded electronics sensors.

Instead of just processors, memory and ASICs, we're looking at a range of different types of electronics

For example, we're developing a MEMS-based sensor for sensing the properties of fluids. The sensor would sense the viscosity of fluid and any contaminant in that fluid. So if there were grease in the water particles, it could sense that. As the properties of the grease were downgraded, it would sense that as well. This means more SoC capabilities and more MEMS systems. They're much more suitable for these kinds of tasks, because you can embed these systems directly. You can put a MEMS electronics sensor in fluid, for example, so the fluid interacts directly with the electronics as opposed to having the electronics sit in an air-conditioned box.

Q: What about wireless and RFID? What's the opportunity there?

Chand: The big pull coming from customers with wireless today is, again, diagnostics and prognostics. Rather than wiring new sensors into an existing infrastructure, you'd rather add wireless sensor nodes to collect data and build diagnostics around it. There's a huge opportunity for these kinds of applications and wireless in general. The key need in terms of electronics is low-power radios that support 802.11-related wireless standards. You could have hundreds of sensors distributed all over

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Jon Kang

Samsung Blurs Line between Vendor, Customer

As electronics products become more complex, they require ever deeper levels of collaboration throughout the supply chain. This presents a challenge, though, because collaboration means breaking down corporate stovepipes so information and ideas can flow freely. At Samsung Semiconductor, senior vice president of technical marketing Jon Kang heads a group that fosters collaboration by blurring some of the distinctions between customer and vendor. Kang embeds Samsung engineers inside major PC, server and consumer electronics firms to help with their design efforts and thus get products to market more quickly. Because these customers include virtually every systems manufacturer in the world, they constitute a key channel for Samsung's $18 billion semiconductor business. Kang's group is thus largely responsible not just for helping customers meet their design goals but also for having helped Samsung achieve its No. 2. market share in worldwide semiconductor revenue. Kang has an electrical engineering degree from the University of Illinois, Urbana-Champaign, and has worked in various development roles at Samsung since 1983. Freelancer Geoffrey James asked him about Samsung's customer strategies.

Q: Why does Samsung embed engineers inside systems firms?

Kang: Through the early '90s, Samsung participated in the semiconductor market primarily as a supplier of personal computer memory. That market was dominated by Microsoft and Intel, which used their market clout to control standards, which tended to force other companies to be suppliers of commodity products. However, when the market for consumer electronics began growing rapidly in the late '90s, we saw the opportunity to provide unique chips that system houses could use to differentiate their products. To make this happen, however, we needed extremely tight communication between the system houses and Samsung's manufacturing empire. Our approach evolved as a way to build a more strategic relationship with our customers.

Q: How does Samsung define a strategic relationship?

Kang: Most supplier relationships in the electronics industry operate under the commodity business model. Essentially, the customer can pick and choose suppliers, based on a combination of price and availability. Our chairman, Dr. Kun Hee-Lee, wanted Samsung to be in the mode where it can provide a solution to a problem, rather than just a product that performs a function. This means working very closely with customers throughout the design and manufacturing chain and being willing to tweak your manufacturing processes to accommodate the unique needs of individual projects. In other words, it's a strategic relationship if the customer sees Samsung as an integral contributor to its long-term success.

Q: What type of firm qualifies as a strategic customer?

Kang: Essentially, we look for companies that are market leaders, even if that market is currently small. For example, Apple has always been a strategic customer for us, but there are cases in which we've helped smaller firms at an earlier stage of development. When the market for GPS devices was just getting under way, for instance, we worked closely with SiRF to build Samsung components into its chip set. Fortunately, that chip set has now become a leader in the growing market for battery-powered GPS devices.

Q: How does a typical strategic relationship work?

Kang: Here's an example. One of our customers built a chip set that contained a significant bug. The Samsung chip that was part of the set was performing exactly according to specification, so technically speaking, it wasn't Samsung's problem. However, our field application engineer who was working with the design team determined that it would probably be easier to make changes in the Samsung chip to work around the bug rather than change the part that was actually malfunctioning. Acting as the customer's advocate, our engineer then convinced Samsung's manufacturing group to make changes to our chip so the customer could get its product released on time.

Q: Didn't that entail extra expense for Samsung?

Kang: Yes, but it allowed our customer to release a successful product that otherwise might have languished. That, in turn, resulted in greater sales for Samsung. More important, our having made a change in our chip to accommodate the customer's bug made it more difficult for a competitor to displace us. In fact, when a competitor did come into the picture, it had created a chip that operated according to the specification but lacked the adjustments we had made to accommodate the bug. The competitor's chip didn't work, and ours did.

Q: To what extent does one of your engineers work for the customer rather than for Samsung?

Kang: They are Samsung employees, but their primary role is to work inside the customer's design shop and work on issues inside Samsung on behalf of the customer. On certain occasions, we have our engineers in the customer labs working together or we have our software engineers working on site with the design teams. I do not want to give the impression that there are many customers that are willing to give full access to their design teams, but strategic customers generally welcome our engineers. We have to put the customers' interests first, otherwise the customers wouldn't trust us enough to include our engineers in their internal design meetings. A lot of the time, we end up spending much of our time negotiating with the rest of Samsung to ensure that our customers' interests and needs are reflected in Samsung's design and manufacturing.

Q: How are you structured?

Kang: We're separated into three groups. The first group handles the big OEMs, such as IBM and Sun Microsystems. The second group works with chip set manufacturers such as Texas Instruments and Freescale Semiconductor, in wireless, or nVidia and ATI, in graphics. In these two groups, there's at least one engineer assigned to work directly with each firm. The third group is deployed regionally to handle a wide range of smaller accounts. Overall, we have about 30 engineers deployed in our customers' organizations across the United States. As you might imagine, they travel frequently to Samsung's manufacturing facilities [in Korea], but we're headquartered in the United States, because the U.S. is still where most electronics products are designed.

They are Samsung employees, but their primary role is to work inside the customer's design shop and work on issues inside Samsung on behalf of the customer.

Q: What are the characteristics you look for when hiring an engineer for these roles?

Kang: A strong educational background is important, but even more important is the ability to learn quickly about new technologies and concepts. We also look for people who are personable, which is a fairly rare trait among engineers. To do the job well, an engineer needs to face different people, day after day, and take into account their egos, desires and limitations. They need to realize that people aren't computers, and they need to sacrifice their own ego to become an effective customer advocate.

Q: What overall impact do your engineers have on Samsung's revenue?

Continued on page 90

Collin Malcolm

Wireless Gadgets in Driver's Seat at Lear

Once automotive electronics get into the car, they're typically in for good. Nobody uses keys anymore—they press the remote. And who would buy a car without power windows?

Automotive interior supplier Lear Corp believes more consumer-type gadgets, led by wireless technology, are next as the car evolves into the third point of connectivity along with home and office.

Lear products are in every major car brand and more than 300 models globally. Despite automotive components supplier troubles linked to the suffering of GM and Ford, Lear expects growth in 2006 and sees electronics as an increasing part of its business.

Berlin-based freelancer Drew Wilson spoke to Collin Malcolm, VP of operations for the Electrical Systems division.

Q: Please summarize Lear's electronics division.

Malcolm: Globally the electronics division had $3.2 billion in sales, approximately 19 percent of Lear's total revenue. [The division includes] 44 manufacturing facilities and four technology centers in 17 countries. Products are wireless-type products such as remote keyless entry, tire-pressure monitors, immobilizers, passive entries, and seat belt reminders.

We don't do the semiconductor R&D ourselves. We work closely with the semiconductor industry to develop our technology. Some companies we've worked with are Infineon, Freescale and On Semiconductor.

Q: Where are the biggest opportunities in 2006-7?

Malcolm: In the wireless area. We have great RF technology. With wireless, one of the big ones now is remote start. I sit in my office and start my car from the window. The car warms up and I get in. Living in Michigan, in the wintertime, I love it. I don't think I'll buy a car without it again. Lear has a technology where what's going on in the car can be displayed on the key fob. It will show you the [engine] temperature, how long the car has been running. If someone enters the vehicle, it will alert you. That product is in the aftermarket. It's developed and ready to go, and OEMs are looking at it.

Second, in power distribution systems. Power distribution [involves Lear planning] the entire electrical architecture in the vehicle. We lay out exactly how that vehicle will manage overall power and how all the features and functions work. That allows us to understand how a particular OEM is going to approach its vehicle architecture. Once we help them lay that out, it allows us to help select the different kinds of body module

functions from an electronics standpoint.

One of the biggest opportunities is where we supply audio and infotainment technology. We had a demonstration of our capabilities recently with a BMW outfitted with our audio system, our iPod, rear seat entertainment and navigation system. We have the ability to bring all of that to the OEM. We have audio and infotainment in one of our centers of excellence in Germany and are looking to transplant that in the U.S.

Hybrid type vehicles are also catching on. We are working with automakers on that technology as well as body modules because their function in vehicles is increasing and we're seeing niche opportunities there.

Q: How will hybrid cars impact automotive electronics?

Malcolm: Hybrid cars will not necessarily have increased electronics content, but the value of the electronics content will be higher. Before, we were just spending R&D money on certain technologies like the big voltage wires and different connectors that are needed. Now, with the North American OEMs pushing a little harder to increase hybrid [car production], more R&D dollars are going there. With hybrid, there are a number of software-type things that have to control the vehicle's body functions. Software will control how the vehicle will work as a system [because with hybrid cars] different things happen at a different times and you need electronics for control.

OEMs usually have a hybrid version and a regular version of a vehicle so if we do not have the ability to help on the hybrid side we may not be able to do the other 95 percent of volume. We see hybrid cars picking up. Everyone is working on some version, especially with the issue of natural resources.

Q: Do you expect Lear's electronics division to be a significantly bigger percentage of revenues in two to three years?

Malcolm: I believe that's true. We do not want to give a number where we want to be. But we see a 10 percent growth in the OEM area for electronics every year because they're just adding more features, and once a feature goes in, people want to keep it. Electronics are an area of focus for this company because that's what consumers want. The margins are also better in electronics than in other areas. ■

Chand *continued from page 85*

a factory, and replacing batteries would be a significant challenge. Low-powered radios with integrated processing address that concern.

RFID is another major trend, primarily in the distribution center. For Rockwell, however, the electronics are not a big issue, because we're not in the business of producing RFID chips or readers. We see ourselves in more of a systems integration role, taking the data out of the RFID tags and integrating it with our control systems. We don't see using RFID to produce a new product; we see it certainly playing a role in a lot of new solutions. We see providing software support for getting RFID data into our controls, manipulating that data and moving it out.

Q: Integrated security and safety mechanisms are key directions for Rockwell's future product offerings. How will electronics enable you to address these critical feature sets?

Chand: Safety and security are a huge deal today. Security is driven primarily by the fact that the networks being utilized in industrial automation are open, and the fastest growing is Ethernet. That, coupled with the trend of integrating previously isolated factory floor operations with ERP and the external world, certainly introduces the element of opening up factory controls to a hacker or someone from the outside. Whether you're a factory producing chemical stuff, which could be dangerous, or a manufacturer producing Coca-Cola and not wanting anyone to steal your recipe, security becomes very important. There's an increasing role for electronics in terms of sensing—such things as area sensing, light curtains and more and more opteoelectronics.

Safety is equally important. As you increase automation, you have a lot of moving machines and robots and you need to create an environment that is 100 percent safe for humans. If someone accidentally walks into an area where there's the potential for being hurt, the system needs to automatically shut down or protect the human from coming into harm's way. The trend, then, will be to integrate sensors more into the design of the control system and consider them at the beginning of a factory's construction—as opposed to being a separate, after-the-fact solution. You'll see more light-sensing opteoelectronics and multiprocessing electronics with fault-tolerance capabilities built in.

Q: Is the sector going to see evolutionary or revolutionary changes with respect to electronics?

Chand: With respect to electronics in the industry controls segment, there will be no dramatic change or shifting. It's really more evolutionary. ■

Kang *continued from page 87*

Kang: If our entire group suddenly vanished, the immediate impact on Samsung's revenue would be minimal. The majority of our work reaches fruition in six to 24 months, depending upon the complexity of the project. Without these engineers to act as customer advocates and liaisons to Samsung manufacturing, there'd be a real danger that Samsung might revert back to becoming just another commodity supplier, which would ultimately reduce both revenue and profits.

Q: In your view, what will be the next big thing in electronics?

Kang: Even though I'm in the position to observe advanced development efforts inside a wide range of successful companies, it's difficult to see beyond the current trend, which is toward a more mobile consumer. However, I believe that three areas are likely to generate major industry growth over the next decade or so. The first is robotics; there's a great deal of highly creative work going on in this area, although it's yet to develop into a major market. The second is tight networking. Today's networks — in the office, home and mobile environments — are cobbled together from different standards and consequently difficult to set up and use. I think consumers would welcome a chip-based solution that allowed devices to talk together seamlessly and securely, without all the unnecessary complexity. Finally, I believe that health care is an area with huge potential. There are products on the drawing board that may revolutionize the diagnosis of disease. For example, we're looking at an application that consists of a tiny wireless camera that you swallow like a pill, allowing observation of the condition of your intestinal tract. Such a device might make uncomfortable procedures such as colonoscopy obsolete.

Q: How will your group help Samsung participate in those developing markets?

Kang: We're already involved in many projects that will make that vision a reality. More important, we have the breadth of expertise to contribute to innovative product design efforts at any number of levels. Samsung is one of a very few companies that have extensive experience with memory, processors, displays and so on. We may not always have the lowest price, but by deploying engineers inside our customers' organizations, we can make it easier for the customers to succeed, which, in the long run, is more economical than buying on the cheap and then seeing your product miss the market window. ■

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Cost drives migration

of electronics manufacturing

by Andrew Fletcher

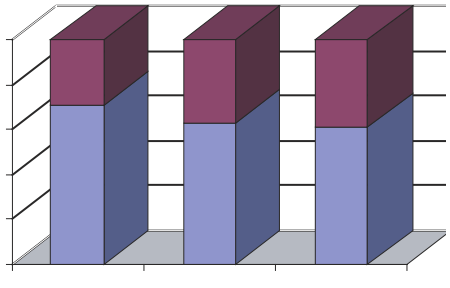
As manufacturers seek to reduce costs, there has been a marked shift in electronics output from high-cost to low-cost locations. Although Asia/Pacific—in particular, China—has been the main beneficiary, Central and Eastern Europe, Mexico and Brazil have also benefited from significant inward investment. In the longer term, many of today's low-cost locations will also offer significant market opportunities, creating the need for further investment in local manufacturing.

In 1995, production in "high-cost" locations (such as the United States, Western Europe and Japan) accounted for 75 percent of electronics output.

By 2000, this figure had already fallen to 67 percent. However, since the collapse of the IT bubble, in 2000, the transfer of production has accelerated, and in 2005, high-cost locations accounted for only 53 percent of the total, according to preliminary figures from Reed Electronics Research. Between 1995 and 2005, Asia/Pacific's share of global electronics production increased from 20 percent to 38 percent. More important, during this period, China's share of global electronics production increased from 3 percent to 16 percent and transformed the structure of the global electronics industry.

Since 1973, the *Yearbook of World Electronics Data* has provided market and production data on the global electronics industry. Through either its four published volumes, individual country reports or custom research, the yearbook database is the definitive source of statistical data on the global electronics industry. For further information on the yearbook and Reed Electronics Research, please visit www.rer.co.uk.

Production Migrates from High- to Low-Cost Locations 1995-2005



Source: Yearbook of World Electronics Data, Reed Electronics Research (www.rer.co.uk)

ASIA/PACIFIC

Although now seemingly overshadowed by developments in China, the rest of the Asia/Pacific region has played an important role in the global electronics industry, initially through investments by European, Japanese and U.S. companies but also through the emergence of major indigenous companies, primarily in South Korea and Taiwan, that have established a major presence within the global market.

Reflecting the trend of reduced costs and proximity to emerging markets, South Korean and Taiwanese companies, like their Japanese and Western counterparts, are looking to reduce costs, including migrating production offshore. China has once again been a major beneficiary. An example is the Taiwanese computer industry. In 2004, the proportion of computer goods produced by Taiwanese companies domestically fell to 8.3 percent, with China accounting for 85.1 percent and other countries 6.6 percent.

Asian companies are also investing in low-cost locations outside Asia/Pacific. With its proximity to Western Europe and the potential for strong market growth, Eastern and Central Europe have in particular benefited from recent investments in consumer electronics production and most notably TV manufacturing.

South Korea, Malaysia, Singapore and Taiwan are all ranked in the top 10 countries globally in terms of production. As highlighted, South Korean and Taiwanese companies already compete globally. In other countries such as Singapore and Malaysia, with significant government support, companies are looking to focus on high-value products and move away from low-cost assembly, where they are finding it increasingly difficult to compete.

Although China will continue to gain global share over the next five years and eventually surpass the United States as the largest electronics producer, the rate of growth is expected to slow.

Rising labor costs, high employee turnover, power and water shortages and the strengthening of the yuan are some of the factors that will contribute to the expected slowdown in growth. The recent anti-Japanese sentiment and the Taiwan government's tougher stance against China, including a firmer role in controlling investments in the country, could also limit future investment.

Thailand, Indonesia and the Philippines all have established electronics industries, and these countries should continue to attract foreign investment. Large potential markets and the move by foreign companies to spread risk and invest outside of China are helping fuel growth.

Vietnam, with its relatively high-quality, low-cost workforce, is also being viewed as a potential long-term rival to China. Vietnam is already benefiting from rising inward investment but, with electronics output of around $2 billion, remains small in global terms. Although Vietnam has to overcome several issues if it is to increase its attractiveness as a low-cost manufacturing location—in particular the need to upgrade its infrastructure—it will increase its share of global electronics output, with Taiwanese and Japanese companies as major investors in the country.

A greater threat to China is the emergence of India. According to the latest figures from the *Yearbook of World Electronics Data*, electronics production increased by 9.7 percent in 2005, following two years of very strong growth of more than 16 percent. With India's surging domestic market and rising exports, major foreign companies have significantly increased investment there. Like other low-cost locations, India will need to invest in infrastructure as well as develop the current component supplier base to meet its full potential. However, an improved regulatory environment that supports the growth of the industry, continued foreign investment and a rapidly growing market are expected to result in a surge in electronics output from an estimated $10.6 billion in 2005 to more than $35 billion by 2010.

EUROPE

In Europe, electronics manufacturing is increasingly migrating east. The once preferred locations of Hungary, Poland and the Czech Republic, however, will face increasing competition for inward investment—in particular for greenfield sites.

At $31 billion, Eastern Europe accounted for just under 13 percent of the overall European total in 2005. Looking ahead, production in Eastern Europe is expected to rise substantially as new plants come onstream. By 2010, Reed Electronics Research forecasts, Eastern Europe will account for almost 20 percent of European electronics output, which is forecast to be in excess of $275 billion. It is worth noting that although Western Europe is losing share of both European and global electronics production, it will remain a significant market opportunity.

NORTH AMERICA

The same applies for the United States, the world's largest producer of electronics. In 1995, the United States accounted for 27.4 percent of global electronics production. By 2000, this had increased to 28.2 percent, as the country benefited from the Internet-led boom. However, since then, the United States has lost share as companies have accelerated the migration of production to low-cost locations and will account for an estimated 20.8 percent of global electronics production in 2005, according to preliminary figures from Reed Electronics Research.

Percentage of Electronics Output by Location 1995-2005

%	1995	2000	2005+
High-cost	75	67	53
U.S.	27	28	21
Canada	1	1	1
Japan	26	20	14
Western Europe	21	18	17
Low-cost	25	33	47
Asia/Pacific	20	26	38
China	3	6	16
Eastern Europe	1	2	2
Rest of World	4	5	7
Total	**100**	**100**	**100**

+ Preliminary

Source: Yearbook of World Electronics Data, Reed Electronics Research (www.rer.co.uk)

Mexico, although facing significant competition from Asia (primarily China), continues to attract investment, due to its proximity to the U.S. market. Between 2000 and 2003, electronics output in the U.S. fell by 34 percent. Reflecting the upturn in the market, electronics output in the U.S. increased by around 8.5 percent in 2004 and, from initial estimates, a more modest 2.7 percent in 2005. Initial forecasts for 2006 are for growth of 4 percent.

JAPAN

Japan accounted for 26 percent of electronics output in 1995. By 2005, this had fallen to 14 percent, according to initial estimates. Although Japanese companies have for many years transferred low-end, high-volume production offshore, the production of high-end products and the introduction of new products have continued to be undertaken domestically.

Strong demand for digital consumer electronics helped increase output in Japan by 2.3 percent in 2003 and by a further 0.1 percent in 2004. However, despite continued demand for flat-panel TVs, production of other consumer electronics equipment, such as DVDs and digital cameras, has since weakened. With the trend mirrored across other sectors of the industry, electronics output in Japan in 2005 is forecast to have declined by 3.4 percent. Although a modest increase is anticipated for 2006, falling prices will put pressure on manufacturing costs in the longer term and result in an increasing proportion of current high-end production's being transferred offshore.

The dynamics of the electronics industry have changed. Volume production is gravitating toward low-cost locations, which, in turn, are the markets that offer the most long-term potential. Lower volume/high-mix products will, however, continue to be manufactured in high-cost locations, creating significant opportunities throughout the supply chain.

In 1995, electronics output was centered on high-cost locations. Today, the industry is global. ■

Andrew Fletcher is research manager for Reed Electronics Research.

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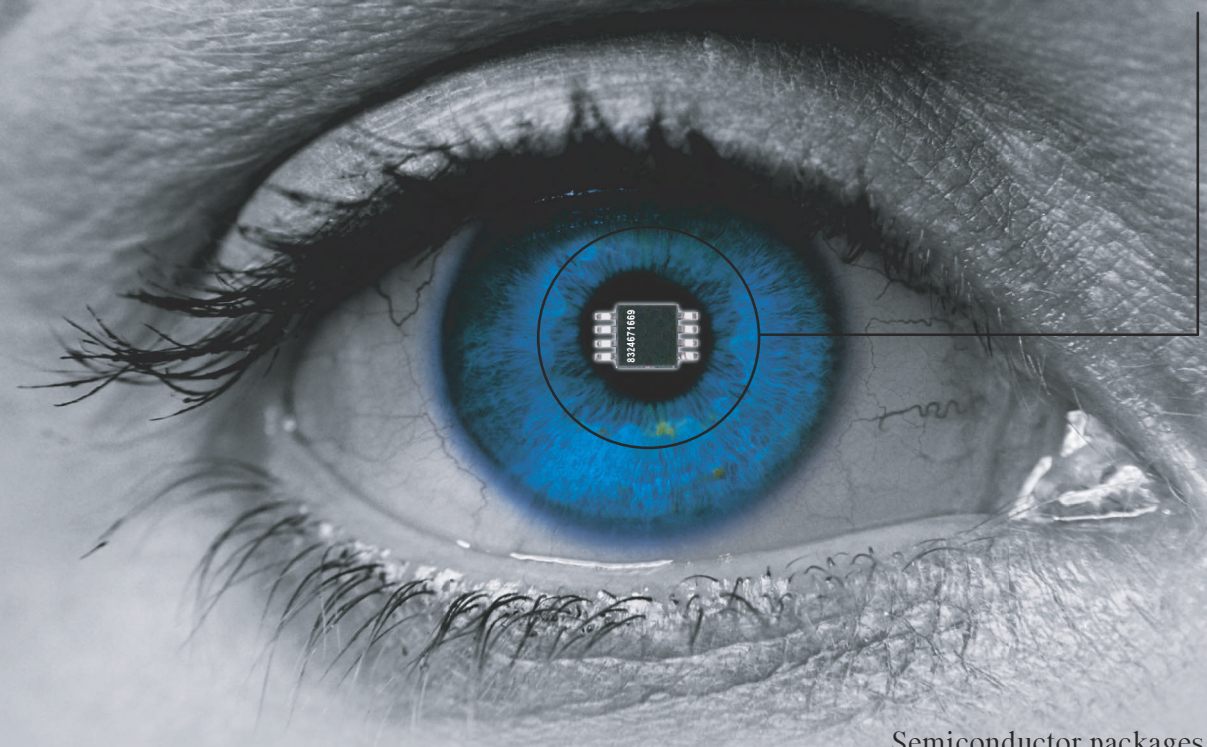

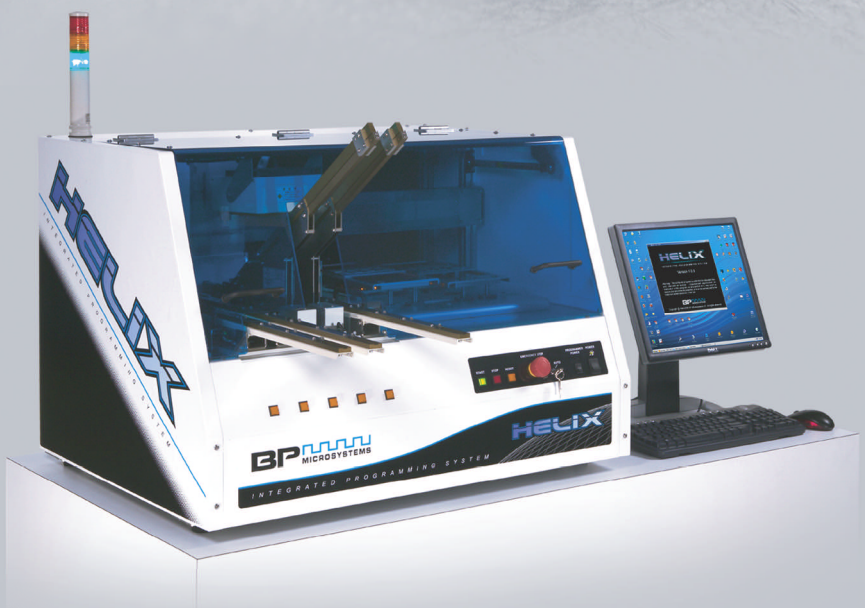

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